CHAPTER

4

MANAGING WINDOWS XP FILE SYSTEMS AND STORAGE

After reading this chapter and completing the exercises, you will be able to:

- Understand basic and dynamic storage
- Understand the drive configurations supported by Windows XP
- Understand the FAT, FAT32, and NTFS file systems
- Understand permissions, sharing, and other security issues related to file systems
- Understand Windows XP drive, volume, and partition maintenance and administration

The Windows XP file storage subsystem offers a versatile disk management system. Windows XP supports both basic and dynamic storage, large disk volumes, fault tolerant drive configurations, and secure access controls. In this chapter, we discuss the basic and dynamic storage methods, the file systems and drive configurations supported by Windows XP, and all of the built-in tools used for disk maintenance.

File Storage Basics

Windows XP supports two types of storage: basic and dynamic. **Basic storage** is the storage method with which most Microsoft PC users are familiar. It centers on partitioning a physical disk. **Dynamic storage** is a new method supported only by Windows XP and Windows 2000. Dynamic storage is not based on partitions but on **volumes**. From a user's perspective, the only difference between basic and dynamic storage is the additional ability to create expanded volumes and fault-tolerant configurations on dynamic drives.

Basic Storage

Basic storage is the traditional, industry-standard method of dividing a hard drive into partitions. A partition is a logical division of the physical space on a hard drive. Each partition can be formatted with a different file system. Partitions must be formatted before they can be used by an operating system.

There are two types of partitions: primary and extended. A single hard drive can host up to four **primary partitions**, or it can host up to three primary partitions and a single **extended partition**. An extended partition can be further divided into logical drives. Only primary partitions and logical drives can be formatted with a file system. Thus, a single hard drive can appear as one or more accessible or usable drives (that is, after the partition is properly formatted).

A primary partition can be marked **active**. This informs the computer's BIOS to see operating system booting information on that partition. Only primary partitions can be active and only a single partition can be active at any time. The active partition does not have to be the first partition on the drive.

In basic storage, volumes are two to 32 partitions combined into a single logical structure formatted with a single file system. Volume sets can be extended simply by adding another partition. But volume sets can be reduced in size only by breaking the set and creating a new set. The act of breaking the set destroys (or at least makes inaccessible) all data stored on the volume. A volume set can span multiple partitions on one or more physical drives. A volume set is represented in the operating system by a single **drive letter**. A volume set provides no fault tolerance. If a single drive or partition in a volume set fails, all data in the set is destroyed.

The new dynamic storage method uses a slightly different definition for the term "volume," so be careful to review the context when it is discussed.

Typically, you'll want to create partitions or volumes as large as the operating system and file system allow. Under Windows XP, those sizes are as follows:

- *FAT*—4 GB
- *FAT32*—32 GB
- *NTFS*—4 TB

Each formatted partition or volume set is assigned a drive letter. Letters A and B are typically reserved for floppy drives, but letters C through Z can be used for formatted partitions and volumes hosted on the hard drive. Thus, only 24 formatted partitions can be accessed from Windows XP. This limitation does not impose a serious restriction in most situations.

The basic storage type supports a wide range of disk configurations, from single, formatted partitions (often called drives or logical drives) to fully fault-tolerant Redundant Array of Inexpensive Disks (RAID-5) configurations. The main difference between basic storage and dynamic storage is that basic storage disk structures require a system reboot when changed.

Windows XP supports this traditional method of storage for backward compatibility. In other words, Windows XP can take over control of drive configurations (see the "Drive Configurations" section later in this chapter) from previous operating systems (Windows 2000, NT, 95, 98, Me, and DOS), provided that the structure conforms to the current restrictions of the file systems they host and that the hosted file system is supported by Windows XP (FAT, FAT32, or NTFS). However, Windows XP does not support creation of basic storage-type drive structures beyond single, formatted partitions. It can manage only existing structures.

Windows XP can be installed only onto basic storage type partitions. There are two partitions associated with Windows XP: **system partition** and **boot partition**. Take careful note of their descriptions, because in our opinion they are labeled backward. The system partition is the active partition where the boot files (required to display the boot menu and initiate the booting of Windows XP) are stored. The boot partition hosts the main Windows XP system files and is the initial default location for the paging file (these are generally the \WINDOWS and \WINNT directories). The boot partition can be the same partition as the system partition, or it can be any other partition (or logical drive in an extended partition) on any drive hosted by the computer. Neither the system partition nor the boot partition can be a member of a volume set or stripe set. They both can be the source of original partition/drive in a disk mirror or disk duplexing configuration. The drive letters of the system partition and boot partition cannot be changed.

Once Windows XP is installed, the boot partition drive can be transformed into a dynamic storage device, but the system partition host must remain a basic storage device.

Dynamic Storage

Dynamic storage is a new type of storage technique (Microsoft documentation labels it as a new standard) introduced in Windows 2000 that does not use partitions. Instead, this method views an entire physical hard drive as a single entity. This entity can be divided into one or more volumes. This storage method offers drive structures from **simple volumes** (entire hard drives as a single formatted entity) to fully fault tolerant RAID-5 configurations. The main difference between dynamic storage and basic storage is that dynamic storage structures can be expanded on the fly without rebooting Windows XP. Furthermore, only Windows 2000 and XP Professional systems can access data on

dynamic storage volumes; most other operating systems, including Windows 95, 98, Me, XP Home, and NT on a multi-boot system cannot access dynamic volumes.

Unlike basic storage drives, dynamic storage drives belong to the OS on which they were created. A dynamic storage volume created by Windows XP must be imported into Windows 2000 on a multi-boot system for Windows 2000 to access its contents. However, this process changes its ownership. The volume must be re-imported into Windows XP to return it to its original owner.

New drives (including existing drives with all partitions deleted) can be transformed into dynamic storage hosts through a selection Wizard. This Wizard is launched when the **Disk Management** tool is accessed (Start | Control Panel | Switch to Classic View | Administrative Tools | Computer Management; Storage; Disk Management) and a physical hard drive is present with no predefined partitions. This Wizard appears only the first time Disk Management is accessed after booting, after adding a new drive or deleting all partitions on a drive. You are prompted whether to enable dynamic storage.

Existing drives with partitions can be upgraded to dynamic storage by using the Convert to Dynamic Disk command. Converting a drive does not cause data loss or any change in the existing partition structure (other than converting them into volumes). Plus, existing drive configurations (mirror, duplex, stripe, and spanned volumes) can be upgraded to a dynamic volume. This command appears in the pop-up menu when you right-click a drive header—not a volume—in Disk Management. The drive(s) must have at least 1 MB of unallocated space, and you must reboot for the changes to take effect.

Once a drive is converted to host dynamic storage, it is labeled as such in Disk Management (see Figure 4-1).

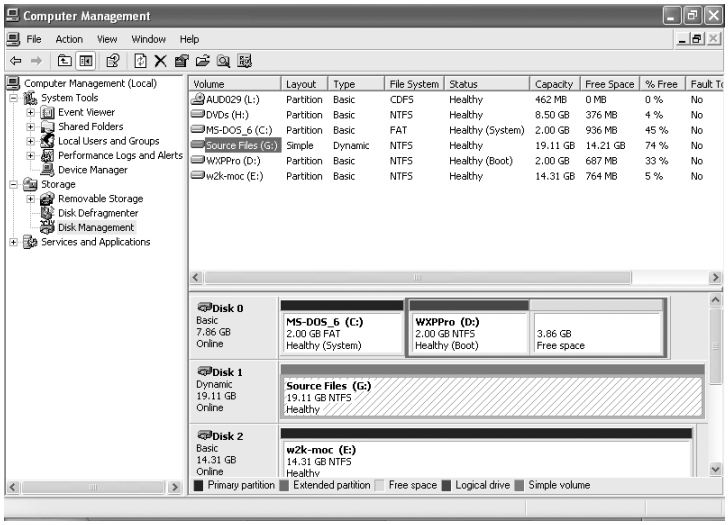

Figure 4-1 A dynamic volume seen through the Disk Management portion of Computer Management

Once you have a dynamic storage host, the next step is to create a volume. A volume is a portion of one or more hard disks that is combined into a single logical structure, formatted with a single file system, and accessed through a single drive letter (also called a **mount point**). To create a volume, perform the following steps:

1. From within Disk Management, right-click an unallocated dynamic storage device and select **New Volume** from the pop-up menu.
2. This launches the New Volume Wizard. Click **Next**.
3. You'll be prompted as to what type of volume to create. Select Simple and click **Next**. (See the section on drive configurations later in this chapter.)
4. Select the available dynamic storage devices and how much of each device to use in the volume being created (see Figure 4-2). Click **Next**.

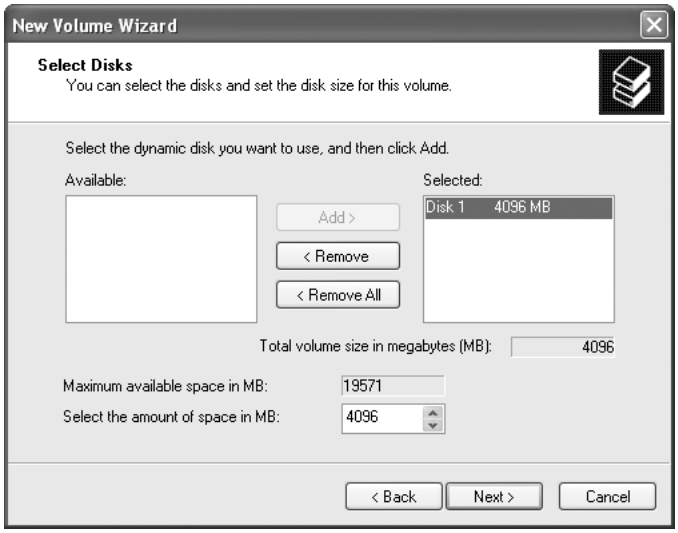

Figure 4-2 Select Disks page of the New Volume Wizard

5. Next, you'll be prompted to select a drive letter, a mount point, or to not assign a drive letter at all (see Figure 4-3). Select the option that suits your purposes and click **Next**. (See the section on drive letters and mount points later in this chapter.)

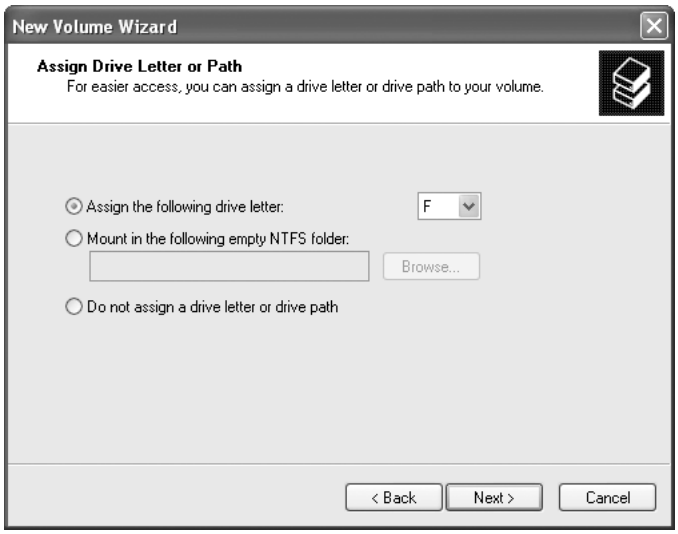

Figure 4-3 Assign Drive Letter or Path page of the New Volume Wizard

6. Select whether to format the volume and with which file system (see Figure 4-4). Click **Next**.

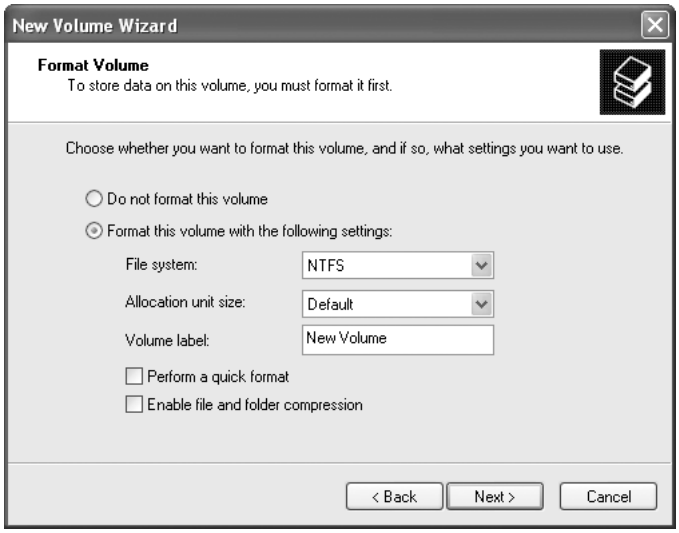

Figure 4-4 Format Volume page of the New Volume Wizard

7. Click **Finish** to implement volume creation.

Table 4-1 Functions and capabilities of basic and dynamic disks

Tasks	Basic Disk	Dynamic Disk
Create and delete primary and extended partitions	X	
Create and delete logical drives within an extended partition	X	
Format and label a partition and mark it as active	X	
Delete a volume set	X	
Break a mirror from a mirror set	X	
Repair a mirror set	X	
Repair a stripe set with parity	X	
Upgrade a basic disk to a dynamic disk	X	
Create and delete simple, spanned, striped, mirrored, and RAID-5 volumes		X
Extend a volume across one or more disks		X
Add a mirror to or remove a mirror from a mirrored volume		X
Repair a mirrored volume		X
Repair a RAID-5 volume		X
Check information about disks, such as capacity, available freespace, and current status	X	X
View volume and partition properties such as size	X	X
Make and change drive-letter assignments for hard disk volumes or partitions and CD-ROM devices	X	X
Create volume mount points	X	X
Set or verify disk sharing and access arrangements for a volume or partition	X	X

Table 4-1 compares the functions and capabilities of basic and dynamic storage devices.

This table was reproduced from the *Microsoft Windows XP Professional Resource Kit* from Microsoft Press.

Dynamic drives can be returned to basic storage by deleting all volumes and issuing the Convert to Basic Disk command on the drive through Disk Management. Because you must delete the volumes first, converting a disk back to basic storage destroys all data on that drive. Therefore, you should always back up all your data before returning to basic storage.

Removable Storage Devices

The inclusion of Plug and Play technology in Windows XP brings support for removable media and storage devices. These **removable storage devices** or storage media can contain only a single primary partition. They cannot participate in dynamic storage. They cannot host extended partitions. They cannot be marked active.

Drive Configurations

Windows XP supports several drive configurations. While maintaining management capabilities for configurations using basic storage type partitions, Windows XP can create new drive configurations using only dynamic storage devices. There are five drive configurations or structures used by Microsoft operating systems, but only the following three are supported by Windows XP:

- *Simple volume*—All or part of a single drive. Does not provide any fault tolerance. NTFS volumes can be extended; FAT and FAT32 volumes cannot be extended.
- *Spanned volume*—A volume configuration of two or more parts (up to 32) of one or more drives, or a volume configuration of two or more entire drives. Elements of the **spanned volume** do not have to be equal in size. Data is written to the first drive in the volume until it is full, then it continues on with the next drive. This is also called an extended volume. Spanned volumes don't provide any fault tolerance: If one partition or volume in the set fails, all data is lost. Spanned volumes cannot be part of a **striped volume** or a **mirrored volume**. NTFS spanned volumes can be extended, FAT and FAT32 spanned volumes cannot. The system volume and boot volume cannot be extended. Volume sets can be reduced in size only by breaking the set and creating a new set. The act of breaking the set destroys all data stored on the volume.
- *Striped volume*—Two or more volumes (up to 32) of one or more drives or two or more entire drives (up to 32). Data is written to all drives in equal amounts (in 64 KB units) to spread the workload and improve performance. Each part or drive must be roughly equal in size. Striped volumes do not provide any fault tolerance: If one partition or drive in the set fails, all data is lost. Striped volumes cannot be mirrored or extended. Boot and system partitions cannot be part of a striped volume.

No matter what disk configuration is used, always protect your data by using a regularly scheduled backup system.

File Systems

Windows XP supports the **File Allocation Table** (**FAT**; also called **FAT16**), **FAT32**, and **New Technology File System (NTFS)** file systems. Windows XP retains FAT for backward compatibility with other operating systems. This allows easy upgrade from another operating system to Windows XP and enables multi-boot systems to **share** data drives (when basic storage is used). FAT32 is used to support larger volumes and offer multi-boot shared drives with Windows 98, Me, and Windows 95 OSR2. NTFS is the

preferred file system to use with Windows XP. It offers, among other things, significantly larger volume support, file by file compression, and file by file security. Windows XP NTFS volumes can be accessed by Windows NT 4.0 with Service Pack 4 applied and Windows 2000 systems. However, Windows NT 4.0 will be unable to access files that are using features not present with NTFS when NT 4.0 was released (such as encryption via EFS).

FAT and FAT32 are both collectively referred to as FAT in most Microsoft documentation. The separate terms are used only when the distinctions between FAT and FAT32 are important.

FAT, FAT32, and NTFS all support **long file names (LFNs)** with lengths up to 256 characters. FAT and FAT32 store 8.3 equivalents of LFNs for compatibility with DOS-based utilities that do not recognize LFNs. It is important to use LFN supporting utilities when performing any disk or file operation involving LFNs.

FAT and FAT32

FAT, also known as FAT16, was originally developed for DOS. It has experienced several revisions and upgrades as support for FAT was included in newer operating systems. FAT under Windows XP maintains backward compatibility with previous operating systems while supporting newer features or capabilities. In addition, on Windows XP, FAT is most often used to format floppies and other removable media.

Here are the important features of FAT (under Windows XP):

- Supports volumes up to 4 GB in size
- Most efficient on volumes smaller than 256 MB
- Root directory can contain only 512 entries
- No file-level compression
- No file-level security
- Maximum file size is 2 GB

FAT32 is simply an enhanced version of FAT originally released with Windows 95 OSR2. FAT32's main feature change is its volume size. Windows XP can support and access FAT32 volumes up to 2 TB in size, but only volumes up to 32 GB can be created. FAT32 volumes have a minimum size of 512 MB, with a maximum file size of 4 GB.

A FAT volume is divided into clusters. A **cluster** is a group of one or more **sectors** divided into a single non-divisible unit. A sector is the smallest division (512 bytes) of a drive's surface. Due to the limitations of the file system, only a maximum number of clusters can be addressed. For FAT16, the maximum number of clusters is 65,536. For FAT32, the maximum number of clusters is 268,435,456 (see Table 4-2).

Table 4-2 FAT16 and FAT32 Cluster Sizes

Drive Size	FAT16 Cluster Size	FAT32 Cluster Size
260 to 511 MB	8 KB	Not supported
512 to 1023 MB	16 KB	4 KB
1024 MB to 2 GB	32 KB	4 KB
2 to 4 GB	64 KB	4 KB
4 to 8 GB	Not Supported	4 KB
8 to 16 GB	Not Supported	8 KB
16 to 32 GB	Not Supported	16 KB
>32 GB	Not Supported	32 KB

Before the release of Windows 95, the maximum allowable FAT volume size was 2 GB. But with the use of 64 KB clusters, this was extended to 4 GB. However, 64 KB clusters caused problems with some older drive utilities. Thus, Windows XP always warns you when you attempt to format a 2 GB to 4 GB partition with FAT16.

NTFS

NTFS is the preferred file system of Windows XP. Here are the important features of NTFS under Windows XP:

- Supports volumes up to 2 TB in size
- Most efficient on volumes larger than 10 MB
- Root directory can contain unlimited entries
- File-level compression
- File-level security
- File-level encryption (see Chapter 6, "Windows XP Security and Access Controls")
- **Disk quotas**
- POSIX support (POSIX subsystem support is not included in Windows XP Professional)
- File size is limited only by the size of the volume

The version of NTFS included with Windows XP (NTFS v5) is different from that of Windows NT out of the box (NTFS v4). In fact, you must have Service Pack 4 installed on Windows NT to access Windows XP NTFS volumes. Microsoft does not recommend a multi-boot system with pre-SP4 Windows NT and Windows XP for this reason.

FAT and FAT32 volumes on a system can be migrated to the NTFS format without losing data. However, to return to FAT, the volume must be deleted, re-created, and formatted, and the data must be copied back onto the new volume.

NTFS manages clusters more efficiently than FAT32, see Table 4-3.

Table 4-3 NTFS Default Cluster Sizes

Volume Size	Sectors Per Cluster	Cluster Size
512 MB or less	1	512 bytes
513 to 1024 MB	2	1 KB
1025 to 2048 MB	4	2 KB
2049 to 4096 MB	8	4 KB
4097 to 8192 MB	16	8 KB
8193 to 16,384 MB	32	16 KB
16,385 to 32,768 MB	64	32 KB
> 32,768 MB	128	64 KB

File-level compression cannot be used on volumes with a cluster size greater than 4 KB.

Converting File Systems

When you first format a drive in Windows XP, you have the option of selecting FAT, FAT32, or NTFS. If at a later date you decide you need to change the format, you have only two options: reformat with the new file system or convert from FAT/FAT32 to NTFS. A backup should precede either process to ensure that you will not lose data.

The first option of reformatting is easy; simply employ one of the disk tools, such as Disk Management, and format the volume with a new file system. Remember that all data stored on the drive will be lost, so without a backup you will not be able to recover from a format. The second option employs the CONVERT.EXE command line tool. This tool can be used to convert FAT or FAT32 volumes to NTFS. It has two command line parameters: /fs:ntfs and /v. The first specifies the conversion that should result in the NTFS file system (it is strange to have this parameter because it only supports conversion to NTFS). The second turns on verbose mode so all messages regarding the conversion are displayed. When launched, CONVERT attempts to convert the drive immediately. If the drive is locked (i.e., a process has an open file from the volume to be converted), the conversion will occur the next time the system is booted up.

If you use the CONVERT command to initiate a conversion to NTFS, and decide before the reboot that you don't want to convert the volume, you can cancel the process. To cancel a CONVERT action, you must edit the Registry. Using REGEDT32, locate the BootExecute value entry in the \SYSTEM\CurrentControlSet\Control\Session Manager key. Change the content of that value entry from "autoconv \DosDevices*x:* /FS:NTFS" (where *x* is the drive letter of the volume) to "autocheck autochk *". This action prevents the NTFS conversion.

File Compression

File-level compression is the ability to compress data on the basis of single files, folders, or entire volumes. File compression offers the benefit of being able to store more data in the same space, but at the cost of some performance. The amount of compression achieved depends on the data stored in the object (that is, text can often be compressed significantly, whereas executables cannot). Windows XP Professional manages the compression through the NTFS file system drive. Each time a compressed file is read, it must be uncompressed while it is being read. Likewise, when saving a compressed file, copying a file into a compressed folder, or creating a new file in a compressed folder, the data to be stored must be compressed in memory before it is written to the drive.

Configuring and managing file compression involves enabling or disabling the file compression attribute on one or more files or folders. File compression appears as just another attribute of NTFS file/folder objects on the Advanced Attributes dialog box. And, just like all other attributes, file compression can be set on a file by file basis or by setting the attribute on a container. When the "Compress contents to save disk space" checkbox is selected, the object(s) are compressed. When this checkbox is cleared, the object(s) are expanded back to their original size. Troubleshooting compression usually involves either recompressing or removing compression from files or restoring files that were damaged during the compression process from backup.

Disk Management Actions

In addition to creating volumes and transforming devices into dynamic storage, the Disk Management tool offers several other useful features. The All Tasks submenu of the Action menu is context-based, depending on the type of object selected. The All Tasks submenu is the same menu that pops up when you right-click a drive/partition/volume object. Here are the commands that appear in this menu:

- *Change Drive Letter and Paths*—Changes the drive letter of basic disks and dynamic disks or the mount point of dynamic disks.
- *Convert to Basic Disk*—Transforms a dynamic disk into a basic disk; requires that all volumes be deleted.
- *Convert to Dynamic Disk*—Transforms a basic storage device into a dynamic storage device.
- *Delete Partition*—Destroys a partition and returns the space to unallocated status.
- *Explore*—Opens the selected volume or partition in a Windows Explorer window.
- *Extend Volume*—Adds additional unallocated space to an existing volume.
- *Format*—Formats a volume or partition with a file system.
- *Help*—Opens the Help utility.

- *Import Foreign Disks*—Imports a dynamic disk when moved from one Windows XP computer to another.
- *Mark Partition as Active*—Marks a primary partition active.
- *New Logical Drive*—Creates a new logical drive within an extended partition.
- *New Partition*—Creates a partition on a basic disk.
- *New Volume*—Launches a Wizard to create a new simple, spanned, or striped volume.
- *Open*—Opens the selected volume or partition into a new window.
- *Properties*—Opens the Properties dialog box for the selected object.
- *Reactivate Disk*—Brings dynamic disks back online after being powered down, disconnected, or corrupted.
- *Reactivate Volume*—Recovers volumes from a failed status.
- *Remove Disk*—Deactivates a removable drive.

The Action menu itself has two other non-context sensitive commands:

- *Refresh*—Updates drive letters, file system, volume, and removable media information and determines which previously unreadable volumes are now readable.
- *Rescan Disks*—Updates hardware information by rescanning all attached storage devices (including removable media) for changes in configuration. This command is useful if you've added or removed a drive and the display has not been updated to accommodate the change.

Disk Management can be used to manipulate storage devices on remote computers. Simply select the "Computer Management (Local)" item in the console tree and issue the "Connect to another computer" command from the Action menu. This opens a list of all known networked systems. Once you've selected another system, you can perform the same disk management functions as if you were sitting at that machine.

The Properties dialog boxes of drives, volumes, and partitions offer additional details and configuration settings. A drive's (not volume or partition) Properties dialog box (see Figure 4-5) has four tabs: General, Policies, Volume, and Driver. This Properties dialog box is the same one accessible from the Device Manager. The General tab displays details about the drive's model, device type, manufacturer, location in drive chain, and status. At the bottom of this tab, you can access the Troubleshooter by clicking the Troubleshoot button and set whether this device is enabled or disabled in the current hardware profile.

Figure 4-5 A drive Properties dialog box, General tab

The Policies tab is used to configure the write caching and safe removal settings for the device. There are two radio buttons: Optimize for quick removal and Optimize for performance. Fixed hard drives are set automatically to "Optimize for performance and allow only the Enable write caching on the disk" checkbox to be controlled (it is marked by default). Removable drives can be configured with either of the two radio button options. However, the latter setting requires the use of the Safely Remove Hardware icon in the taskbar to avoid losing data, whereas the former allows for instant device removal.

The Volume tab (see Figure 4-6) displays additional details about the device and its hosted volumes, including the following:

- *Disk*—The ordinal number of the disk, such as Disk 0, Disk 1, etc.
- *Type*—The storage type: basic, dynamic, or removable.
- *Status*—The status of the device: online, offline, foreign, unknown.
- *Partition Style*—The partitioning scheme used on the drive; options are MBR (Master Boot Record) on x86 systems, GPT (GUID Partition Table) on Itanium systems, or Not Applicable for unknown or uninitialized devices.
- *Capacity*—The maximum storage capacity of the drive.
- *Unallocated Space*—The amount of space not used in a partition or volume.
- *Reserved Space*—The amount of space reserved for use by the operating system.
- *Volumes contained on this disk*—The volumes and capacity of each volume or partition on the drive.

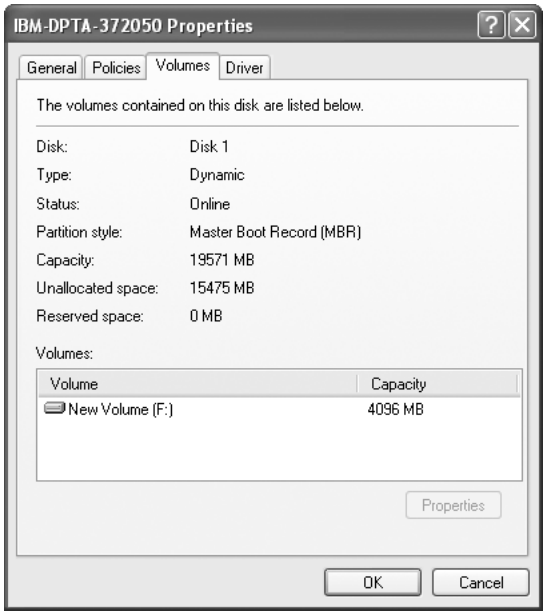

Figure 4-6 A drive Properties dialog box, Volumes tab

The Driver tab displays details about the device driver used by the drive. From this tab, you can: find details about how the driver can be accessed; update the driver or roll back to the previous driver; or uninstall the device driver (that is, remove the device from the system).

You can right-click a partition or volume to access the Properties dialog box. However, an NTFS-formatted partition or volume in a domain has two additional tabs that are not present on FAT/FAT32-formatted partitions or volumes. The tabs of the Properties dialog box are: General, Tools, Hardware, Sharing, Security, and Quota (the later two are NTFS only).

The General tab (see Figure 4-7) of a partition or volume Properties dialog box displays the following:

- *Label*—The customizable name of the volume or partition. FAT drives can be labeled with up to 11 characters, whereas NTFS's labels can contain 32 characters.
- *Type*—The type of disk: local, network connection, floppy disk drive, CD-ROM drive, RAM disk, removable drive, or mounted disk.
- *File System*—The file system used on the disk: CDFS (for CDs), FAT, FAT32, NTFS, and UDF (Universal Disk Format common on DVD and compact discs).
- *Used Space*—The amount of space used by stored files.
- *Free Space*—The amount of space still available in the partition.
- *Capacity*—The total amount of space in the partition.

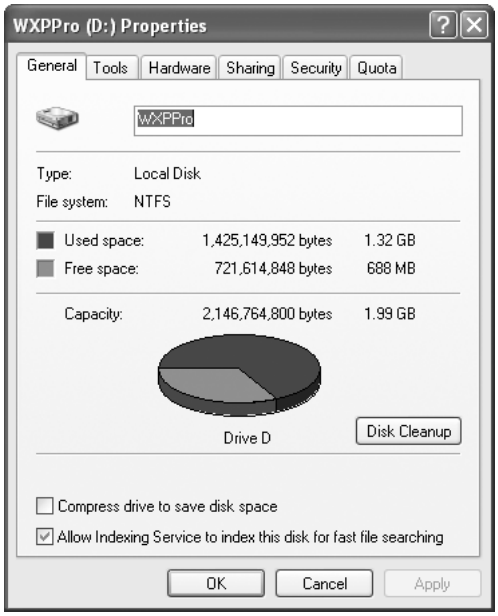

Figure 4-7 A volume Properties dialog box, General tab

- *Graph*—A graphical pie chart representation of used and free space.
- *Disk Cleanup*—A button to access the Disk Cleanup tool (see the "Disk Cleanup" section later in this chapter).
- *Compress drive to save disk space*—By default, files in the root of a drive are compressed automatically; the entire drive will be compressed only when this option is selected.
- *Allow Indexing Service to index this disk for fast file searching*—Indexes the disk.

The Tools tab (see Figure 4-8) offers access to the following:

- *Error-checking*—Accesses the Check Disk tool to find and repair errors on a drive.
- *Defragmentation*—Accesses the **Defragmentation** tool to reduce file fragmentation.
- *Backup*—Accesses the NT Backup utility to back up files (see Chapter 14, "Windows XP Professional Fault Tolerance").

The Hardware tab (see Figure 4-9) lists all physical storage devices and their type. This dialog box accesses the same Troubleshooting and Properties (for drivers) utilities that the Device Manager accesses.

Figure 4-8 A volume Properties dialog box, Tools tab

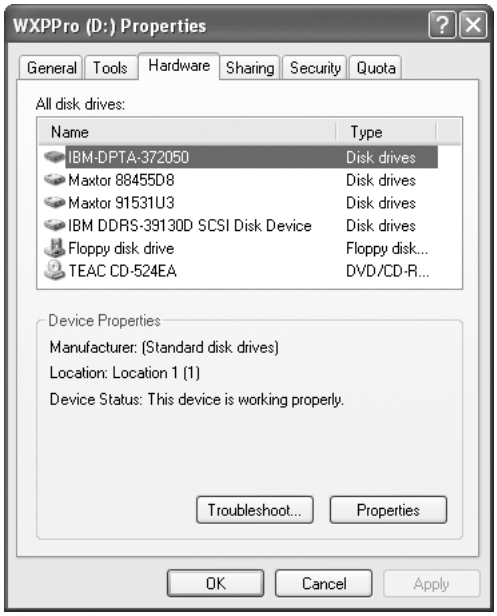

Figure 4-9 A volume Properties dialog box, Hardware tab

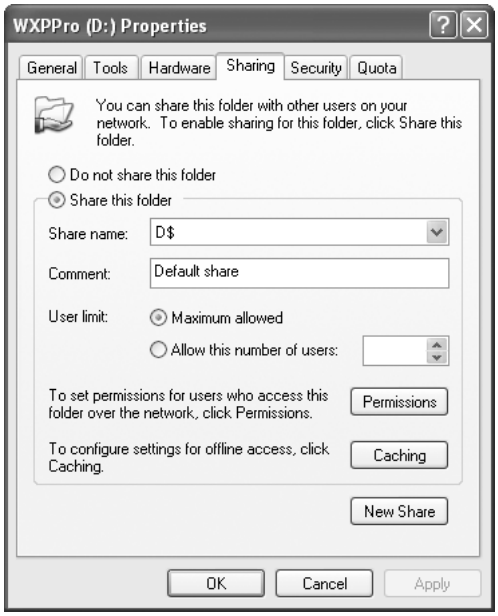

Figure 4-10 A volume Properties dialog box, Sharing tab

The Sharing tab (see Figure 4-10) is used to share partitions with the network. The Security tab (see Figure 4-11) is used to set the NTFS access permissions on the volume or partition as a whole. Individual users or groups can be defined with unique permissions of Allow or Deny for each of the listed object specific actions.

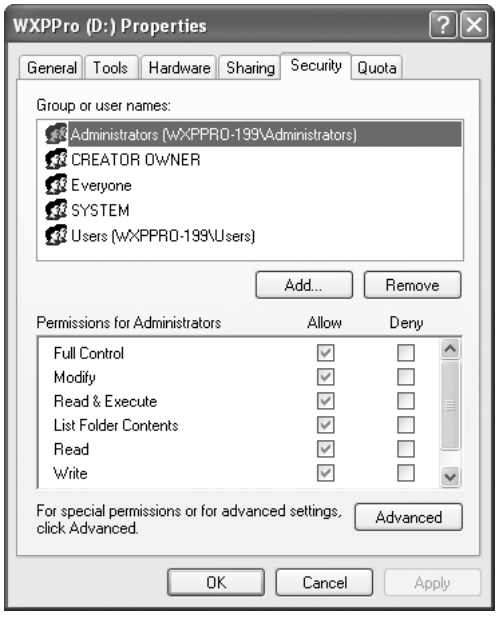

Figure 4-11 A volume Properties dialog box, Security tab

The Quota tab (see Figure 4-12) is used to define disk-use limitations on NTFS volumes and partitions. The quota is defined on a general basis and/or fine-tuned for each individual user. The options include the following:

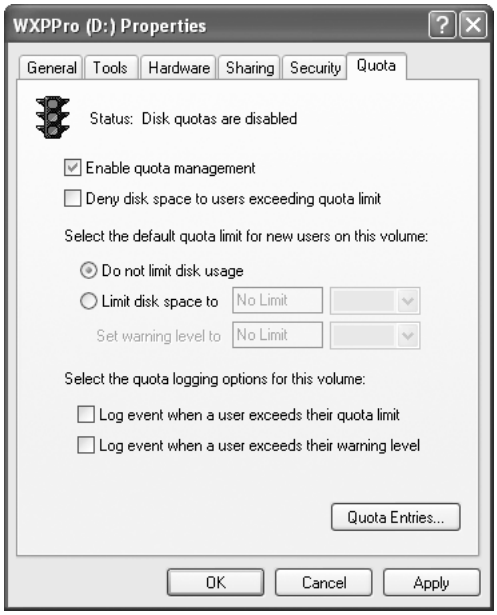

Figure 4-12 A volume Properties dialog box, Quota tab

- *Enable quota management*—Turns on the quota system.
- *Deny disk space to users exceeding quota limit*—Prevents users from gaining more space when in violation of the quota.
- *Do not limit disk usage*—Disables system-wide quota level.
- *Limit disk space to*—Sets maximum amount of drive space that can be accessed by a single user.
- *Set warning level to*—Sets a threshold that, when exceeded, warns users about nearing their quota limit.
- *Log event when users exceed their quota limit*—Adds an item to the Event Viewer.
- *Log event when users exceed their warning level*—Adds an item to the Event Viewer.
- *Quota Entries*—Opens a dialog box where individual quota settings for each user can be fine-tuned.

Drive Letters and Mount Points

Windows XP uses drive letters to grant applications and user interface utilities access to file system resources. Drive letters A and B are typically used for floppy disks, but in the absence of floppy drives, these letters can be employed as mappings for network shares. Drive letters C through Z are used for local hard drives or mappings for network shares. Even without floppies, the first hard drive is always labeled with C. The drive letters assigned to the system and boot partitions/volumes cannot be changed, but all other drive letters can be changed. The Disk Management command of "Change Drive Letter and Paths" is used to alter a drive letter, apply a mount point path, or remove a drive letter. This command is accessed by selecting a volume or partition, and then right-clicking to open the pop-up menu.

A mount point is an alternative to drive letters. A mount point connects a FAT/FAT32 or NTFS volume or partition to an empty directory on an NTFS volume or partition. This allows more than 24 (or 26) volumes to be present on a single machine. The empty directory becomes the gateway to the linked volume. A mount point is created by following this procedure:

1. Create an empty directory.
2. Open the **Disk Management** tool (**Start | Control Panel | Switch to Classic View | Administrative Tools | Computer Management; Storage; Disk Management**).
3. Right-click the volume or partition to be mapped, select **Change Drive Letter and Paths** from the pop-up menu.
4. Click **Add**.
5. Select **Mount in the following empty NTFS folder**.
6. Click **Browse**.
7. Locate and select the empty folder, click **OK**.
8. Click **OK**.
9. To verify that the mount point was defined, use Windows Explorer or My Computer to explore the "empty directory" from step 7. You should discover the directory structure from the mapped volume in step 3.

It is possible to create an infinite-regression mount point by mapping a volume to an empty directory that it hosts. Although this is valid, it can cause system overflows when disk utilities attempt to follow the infinite path.

Disk Cleanup

Disk Cleanup is a tool used to free up space on hard drives by removing deleted, orphaned, temporary, or downloaded files. The utility can be launched from the General tab of the

Properties dialog box from any drive or through Start | All Programs | Accessories | System Tools | Disk Cleanup. When launched from a drive's properties, it automatically scans that drive for space that can be freed. When launched from the Start menu, you are prompted to select the drive to scan for cleaning. The scanning process can take several minutes, especially on large drives that have an excessively large amount of files.

When scanning is complete, the Disk Cleanup for (drive:) dialog box is displayed (see Figure 4-13). The Disk Cleanup tab lists the file types that can be removed and how much space they currently consume. The View Files button can be used to see the selected file type's details through the My Computer window. Selecting the checkbox beside a listed file type causes those files to be deleted (not placed in the Recycle Bin) when OK is clicked.

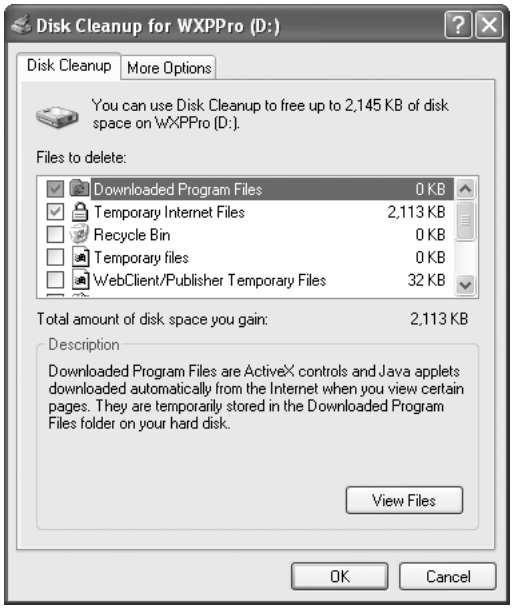

Figure 4-13 Disk Cleanup dialog box

The More Options tab offers access to the Add/Remove Windows Components utility, the Change or Remove Programs utility, and the System Restore utility. The first two of these are the same utilities that can be accessed through the Add/Remove Programs applet in the Control Panel. The System Restore item deletes all but the most recent restore point. See Chapter 14 for more information on System Restore.

Check Disk

Check Disk (Error-checking) is an inspection utility used to examine disk integrity and locate both logical and physical errors on a hard drive. In some cases, logical errors can be corrected. Physical errors are marked and avoided in all future drive accesses by the

operating system. Logical errors are bad pointers in the directory structure of a file system, whether FAT, FAT32, or NTFS. Often these errors can be corrected. However, in those cases where correction is not possible, Check Disk saves the data of orphaned fragments to text files in the root directory of the drive using incremental filenames of FILE0001, FILE0002, etc.

Error-checking—called ScanDisk Check Disk in earlier versions of Windows—is accessed by clicking the Check Now button on the Tools tab of a drive's Properties dialog box. Once launched, it prompts you to Automatically fix file system errors or to Scan for and attempt recovery of bad sectors. Check Disk usually requires rebooting the system to scan NTFS volumes.

The system uses Check Disk when it detects an improper system shutdown or errors in the directory structure of a drive. This usually occurs during boot-up and execution processes, and results are displayed on a blue screen (the one where the operating system name, version, build, number of processors, and memory size is detailed).

The Error-checking tool that ships with Windows XP is specifically designed to manage the file systems supported by Windows XP. Do not use Check Disk or ScanDisk from any other operating system to attempt repairs on Windows XP hard drives.

Defragmentation

As files are written, altered, deleted, rewritten, etc, the storage device develops gaps between used and unused space. As gaps are used to store files instead of contiguous free space, fragmentation occurs. **Fragmentation** is the division of a file into two or more parts where each part is stored in a different location on the hard drive. As the level of fragmentation on a drive increases, the longer it takes for read and write operations to occur. Defragmentation is the process of re-organizing files so they are stored contiguously and no gaps are left between files.

The Windows XP defragmentation utility is designed for FAT, FAT32, and NTFS volumes. Thus, it can reduce or eliminate fragmentation on your hard drives. The defragmentation utility is accessed either from the Tools tab of a drive's Properties dialog box or through Start | All Programs | Accessories | System Tools | Disk Defragmenter.

The Disk Defragmenter (see Figure 4-14) lists all drives in the system. By selecting a drive, you can select one of the following options: Analyze the drive for fragmentation or Defragment the drive. Both processes display a graphical representation of the file storage condition of the drive. Once either process is complete, you can view a report that details the findings of the procedure.

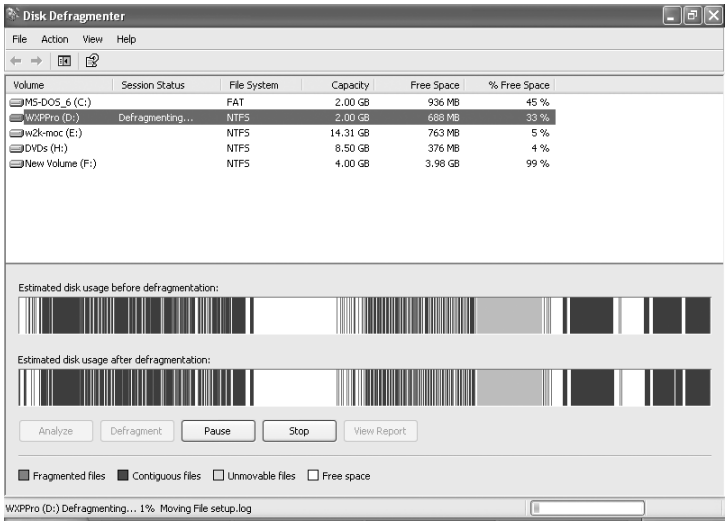

Figure 4-14 Disk Defragmenter

The Disk Defragmenter does not offer a built-in scheduling feature; nor can it be executed from a command line. You must manually defragment or deploy a third-party utility that automates scheduled defragmentation.

FSUTIL

FSUTIL (file system utility) is a powerful command-line utility that can perform a wide range of functions. This tool can be only used by administrators, and even then it should be used with caution. The syntax and parameters of FSUTIL are fairly complex, so take the time to fully review and understand each command before you execute it. For this reason, we are not including an exhaustive list of the syntax and parameters of this tool; instead, we encourage you to use the Help and Support Center to access the online documentation by searching on FSUTIL. The basic commands and actions of FSUTIL are as follows (note: these are the top-level commands, all of them have numerous additional parameters not listed here):

- *behavior*—Defines whether 8.3 character filenames are generated, whether extended characters are accepted in 8.3 filenames on NTFS, how to update the last access timestamp on NTFS volumes, how often quota events are written to the system log, and how much drive space is reserved for the MFT zone.
- *dirty*—Queries, sets, and clears the dirty bit for a volume, which causes autochk to scan the volume for errors upon the next bootup.
- *file*—Finds files by security IDs, sets the 8.3 name of a file, sets the file's valid data length, etc.

- *fsinfo*—Displays information about drives, drive types, volumes, NTFS attributes, and file system statistics.
- *hardlink*—Creates a hard link for a file. All files have at least one hard link. A single file on NTFS can have multiple hard links. Each hard link can be used to access the file. Only after all hard links are deleted is the file actually deleted.
- *objected*—Manages object IDs.
- *quota*—Manages quota settings.
- *reparsepoint*—Queries or deletes reparse points. A reparse point is a file system identifier used by volume mount points and directory junction points.
- *sparse*—Manages sparse files. A sparse file is any file with one or more regions of unallocated data within it. Applications will view the allocated regions as all zeros, even though no disk space is used within that area to represent the zeros.
- *usn*—Manages the USN (update sequence number) change journal which maintains a persistent log of all file system changes made to a volume.
- *volume*—Dismounts or queries volumes for the amount of free space.

File System Object Level Properties

In addition to the drive and volume/partition level controls for storage devices, there are folder- and file-level controls. These controls are accessed through the Properties dialog boxes of either a folder or an object. Plus, there are minor differences depending on whether the file system is FAT/FAT32 or NTFS. Regardless of whether the host has a basic or dynamic disk, there is no difference in file-system objects.

The following sections detail the differences in Properties dialog boxes for each of the object types. The Sharing, Security, and Customize tabs of these dialog boxes are discussed in a later section in this chapter.

NTFS Folder Object

An NTFS folder object's Properties dialog box has four tabs: General (see Figure 4-15), Sharing, Security, and Customize. The General tab offers the following information:

- *Name*—The customizable name of the object.
- *Type*—Lists object type: File Folder.

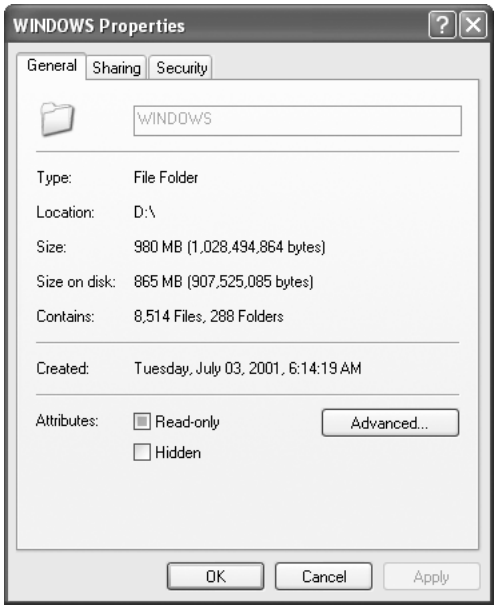

Figure 4-15 An NTFS folder object's Properties dialog box, General tab

- *Location*—The path of the object.
- *Size*—The byte size of the object, including its contents.
- *Size on disk*—The actual amount of drive space used to store the object.
- *Contains*—Lists the number of files and folders it contains.
- *Created*—Lists the creation time and date of the object.
- *Attributes: Read-only*—A checkbox used to prevent writing to, changing, or deleting from the object.
- *Attributes: Hidden*—A checkbox used to hide the object from view.
- *Advanced button (see Figure 4-16): Folder is ready for archiving*—A checkbox that indicates whether this folder and, optionally, its contents is ready for backup.
- *Advanced button: For fast searching, allow Indexing Service to index this folder*—A checkbox that, when selected, pre-indexes the folder, and, optionally, its contents for faster searching.
- *Advanced button: Compress contents to save disk space*—A checkbox used to compress the folder, and, optionally, its contents.
- *Advanced button: Encrypt contents to secure data*—A checkbox used to encrypt the folder, and, optionally, its contents.

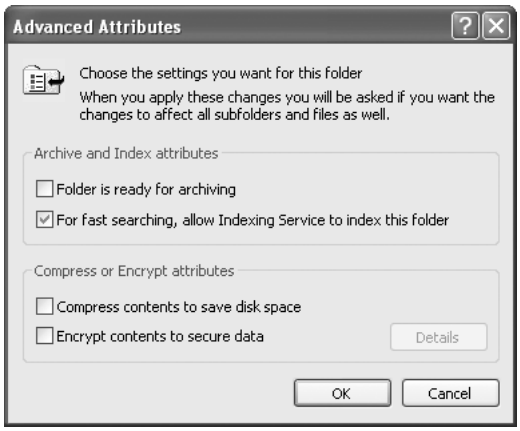

Figure 4-16 Advanced Attributes dialog box

All changes to the settings through the Advanced button requires confirmation once the Properties dialog box for the object is closed by clicking the OK button.

FAT/FAT32 Folder Object

A FAT/FAT32 folder object's Properties dialog box has three tabs: General (see Figure 4-17), Sharing, and Customize. The General tab offers the following information:

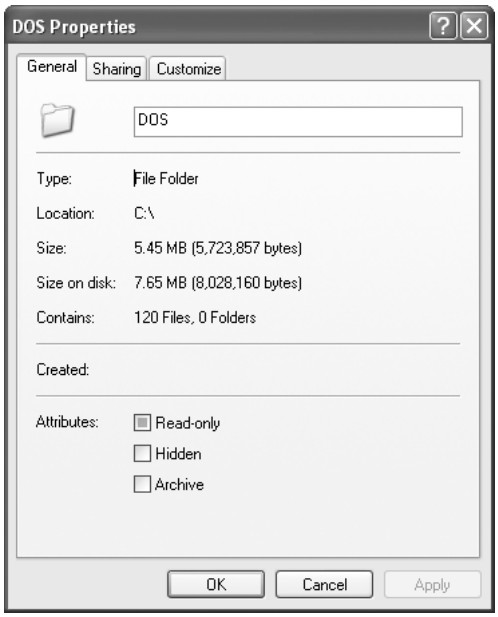

Figure 4-17 A FAT/FAT32 folder object's Properties dialog box, General tab

- *Name*—The customizable name of the object.
- *Type*—Lists object type: File Folder.
- *Location*—The path of the object.
- *Size*—The byte size of the object, including its contents.
- *Size on disk*—The actual amount of drive space used to store the object.
- *Contains*—Lists the number of files and folders it contains.
- *Created*—Lists the creation time and date of the object.
- *Attributes: Read-only*—A checkbox used to prevent writing to, changing, or deleting from the object.
- *Attributes: Hidden*—A checkbox used to hide the object from view.
- *Attributes: Archive*—A checkbox that indicates whether this object should be included in the next backup operation.

NTFS File Object

An NTFS file object's Properties dialog box has three common tabs: General (see Figure 4-18), Security, and Summary. If the NTFS file object is a Windows application, its Properties dialog box has two additional tabs: Version and Compatibility. If the NTFS file object is a DOS application, its Properties dialog box has five additional tabs: Program, Font, Memory, Screen, and Misc. These five additional tabs are used to configure the applications in a DOS environment. See Chapter 11, "Windows NT Application Support" for complete details about these application-specific tabs.

The General tab offers the following information:

- *Name*—The customizable name of the object.
- *Type of file*—Names the file type or defines it as a *blank* file where *blank* is the file's extension; if the type is shortcut, all properties in the dialog box are for the shortcut, not the original item.
- *Description (application files only)*—Names the utility or application.
- *Opens with (non-application files only)*—Lists the application used to open the file.
- *Change (non-application files only)*—A button for altering the application used to open the file.
- *Location*—The path of the object.
- *Size*—The byte size of the object.
- *Size on disk*—The actual amount of drive space used to store the object.
- *Created*—Lists the creation time and date of the object.

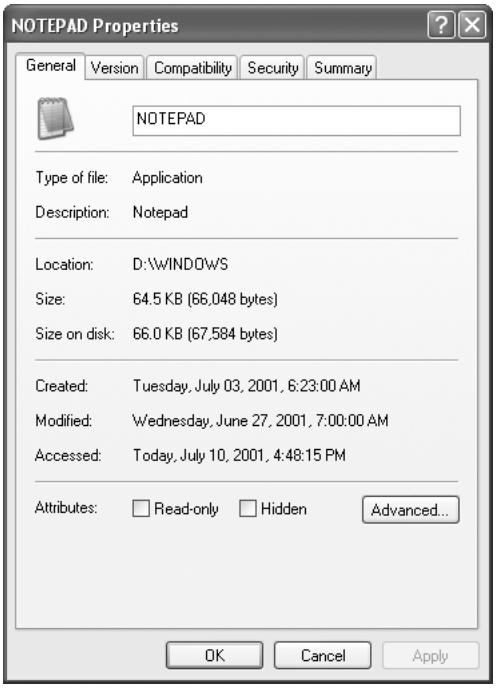

Figure 4-18 An NTFS file object's Properties dialog box, General tab

- *Modified*—Lists the last time and date of a change to the object.
- *Accessed*—Lists the last time and date this object was accessed.
- *Attributes: Read-only*—A checkbox used to prevent writing to, changing, or deleting from the object.
- *Attributes: Hidden*—A checkbox used to hide the object from view.
- *Advanced button: File is ready for archiving*—A checkbox that indicates that this file is ready for backup.
- *Advanced button: For fast searching, allow Indexing Service to index this file*—A checkbox that when selected pre-indexes the object for faster searching.
- *Advanced button: Compress contents to save disk space*—A checkbox used to compress the object.
- *Advanced button: Encrypt contents to secure data*—A checkbox used to encrypt the object.

The Summary tab is used to define description and origin details for the object. These details include Title, Subject, Category, Keywords, Comments, Source, Author, and Revision Number. This information can be used to refine searches.

FAT/FAT32 File Object

A FAT/FAT32 file object's Properties dialog box has a single common tab: General (see Figure 4-19). If the FAT/FAT32 file object is a Windows application, its Properties dialog box has an additional tab: Compatibility. The Compatibility tab is used to configure the application's compatibility with Windows XP, especially if it is a Windows 95, 98, NT 4, or 2000 application. If the FAT/FAT32 file object is a .DLL file or driver file, its Properties dialog box has an additional tab: Version. The Version tab lists the version information for the file. If the FAT/FAT32 file object is a DOS application, its Properties dialog box has five additional tabs: Program, Font, Memory, Screen, and Misc. These five additional tabs are used to configure the application's DOS-run environment. See Chapter 11 for complete details about these application-specific tabs.

The General tab offers the following information:

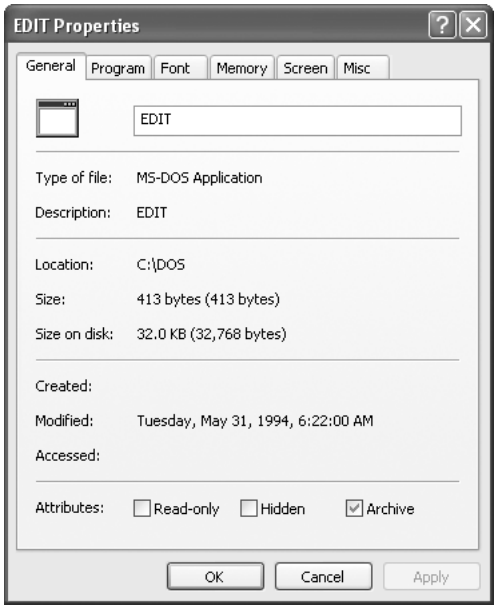

Figure 4-19 A FAT/FAT32 file object's Properties dialog box, General tab

- *Name*—The customizable name of the object.
- *Type of file*—Names the file type or defines it as a *blank* file where *blank* is the file's extension; if the type is shortcut, all properties in the dialog box are for the shortcut, not the original item.
- *Description (application files only)*—Names the utility or application.
- *Opens with (non-application files only)*—Lists the application used to open the file.
- *Change (non-application files only)*—A button for altering the application used to open the file.

- *Location*—The path of the object.
- *Size*—The byte size of the object.
- *Size on disk*—The actual amount of drive space used to store the object.
- *Created*—Lists the creation time and date of the object.
- *Modified*—Lists the last time and date of a change to the object.
- *Accessed*—Lists the last time and date this object was accessed.
- *Attributes: Read-only*—A checkbox used to prevent writing to, changing, or deleting the object.
- *Attributes: Hidden*—A checkbox used to hide the object from view.
- *Attributes: Archive*—A checkbox that indicates that this object should be included in the next backup operation.

NTFS Mounted Volume Object

An NTFS mounted volume object's Properties dialog box has four tabs: General (see Figure 4-20), Sharing, Security, and Customize. The General tab offers the following information:

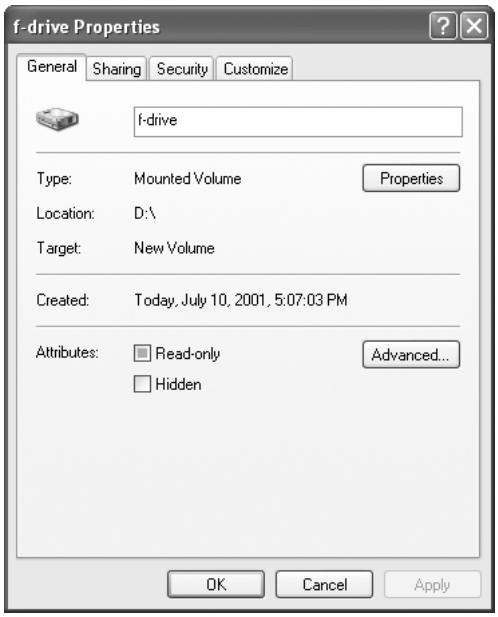

Figure 4-20 An NTFS mounted volume object's Properties dialog box, General tab

- *Name*—The customizable name of the object.
- *Properties*—A button used to access the mounted volume's Properties dialog box, this is the same dialog box as would be seen through Disk Management.

- *Type*—Lists object type: Mounted Volume.
- *Location*—The path of the object.
- *Target*—Names the mapped volume.
- *Created*—Lists the creation time and date of the object.
- *Attributes: Read-only*—A checkbox used to prevent writing to, changing, or deleting the object.
- *Attributes: Hidden*—A checkbox used to hide the object from view.
- *Advanced button: Folder is ready for archiving*—A checkbox that indicates that this folder and optionally its contents is ready for backup.
- *Advanced button: For fast searching, allow Indexing Service to index this folder*—A checkbox that when selected pre-indexes the folder and optionally its contents for faster searching.
- *Advanced button: Compress contents to save disk space*—A checkbox used to compress the folder and optionally its contents.
- *Advanced button: Encrypt contents to secure data*—A checkbox used to encrypt the folder and optionally its contents.

FAT/FAT32 Mounted Volume Object

A FAT/FAT32 mounted volume object's Properties dialog box has three tabs: General, Sharing, and Customize. The General tab offers the following information:

- *Name*—The customizable name of the object.
- *Properties*—A button used to access the mounted volume's Properties dialog box; this is the same dialog box that would be seen through Disk Management.
- *Type*—Lists object type: Mounted Volume.
- *Location*—The path of the object.
- *Target*—Names the mapped volume.
- *Created*—Lists the creation time and date of the object.
- *Attributes: Read-only*—A checkbox used to prevent writing to, changing, or deleting the object.
- *Attributes: Hidden*—A checkbox used to hide the object from view.
- *Attributes: Archive*—A checkbox that indicates that this object should be included in the next backup operation.

MANAGING NTFS PERMISSIONS

The NTFS file system offers file-level control over access on a user and group basis. NTFS is the only file system supported by Windows XP that offers file-level security. NTFS security determines what can be done to a file system object and who can perform those actions. There are different permissions for folders and files.

NTFS File and Folder Permissions

NTFS file and folder permissions are nearly identical. The dialog boxes and control interfaces for files and folders are the same. The only differences are: (1) files do not offer child inheritance options (because files are child objects, they do not have child objects themselves), and (2) some obvious permissions apply only to folders or only to files. In some cases, the same permission name has a different meaning for files and folders. In other cases, similar permissions have different names but both names are listed in both dialog box contexts. The NTFS permissions are as follows:

- *Read*—Allows users to view and access the contents of the folder or the file.
- *Write (folders)*—Allows users to create new folders and files within the folder.
- *Write (files)*—Allows users to overwrite the file and change attributes.
- *List Folder Contents (folders only)*—Allows users to see the names of the contents of the folder.
- *Read & Execute (folders)*—Allows users to reach file and folders through folders in which they do not have access permission; also allows users to view and access the contents of the folder.
- *Read & Execute (files)*—Allows users to run applications and to view and access the file.
- *Modify (folders)*—Allows users to delete the folder and its contents; also allows users to create new folders and files within the folder and to view and access the contents of the folder.
- *Modify (files)*—Allows users to delete the file, to overwrite the file and change attributes, to run applications, and to view and access the file.
- *Full Control (folders)*—Grants users complete and unrestricted access to all functions of the folder and its contents.
- *Full Control (files)*—Grants users complete and unrestricted access to all functions of the file.

These NTFS Permissions are configured on the Security tab of the object's Properties dialog box (see Figure 4-21). This tab offers the following controls:

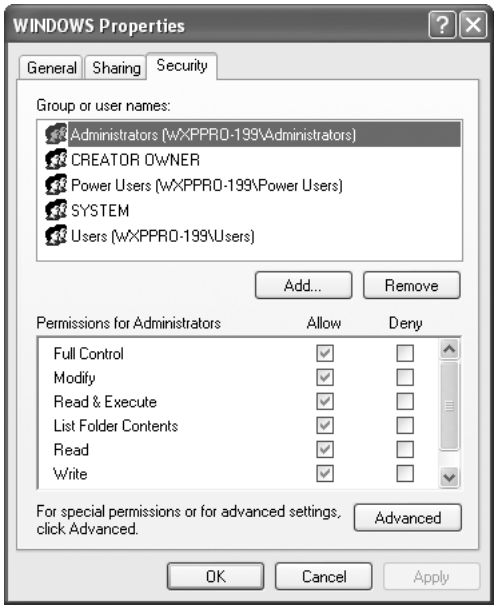

Figure 4-21 The Security tab of an NTFS object's Properties dialog box

- *Group or user names*—Lists the users and groups for which permissions are assigned for this object.
- *Add button*—Used to add users and groups to the Name list.
- *Remove button*—Used to remove users and groups from the Name list.
- *Permissions*—The level of access to be granted or denied to the selected group or user.
- *Allow*—A column of checkboxes used to grant permission to a user/group.
- *Deny*—A column of checkboxes used to restrict permission to a user/group.
- *Advanced button*—Accesses detailed permissions, **auditing**, ownership settings, and effective permissions.
- *Allow inheritable permissions from parent to propagate to this object*—When selected, this enables permissions changes to the parent object to affect this object.

To change permissions for a user or group, select that user or group in the Name list. If the user or group is not present, use the Add button to include that user or group in the list. Once a user or group is selected, the Permissions field displays the current settings

for that specific selection. Selecting or deselecting the Allow or Deny checkboxes for each permission level defines the custom permissions for the selected user or group. To remove a user or group, select it in the Name list and click the Remove button. When a user or group is not listed on the Security tab for an object, that user or group has no effective permissions to that object. In other words, the user or group is prevented from accessing the object.

Clicking the Advanced button reveals a four-tabbed dialog box where more detailed access control settings can be defined. The Permissions tab (see Figure 4-22) of the Access Control Settings dialog box is used to define detailed permissions on a per user or group basis. Similar to the previous dialog box, users and groups are included in the list through the Add button and deleted with the Remove button. This dialog box also offers two more checkboxes. The first checkbox is the same inheritable permissions as was seen on the previous dialog box. The second checkbox appears on folder dialog boxes only and states: *Reset permissions on all child objects, and enable propagation of inheritable permissions*. This control resets child object inheritance settings.

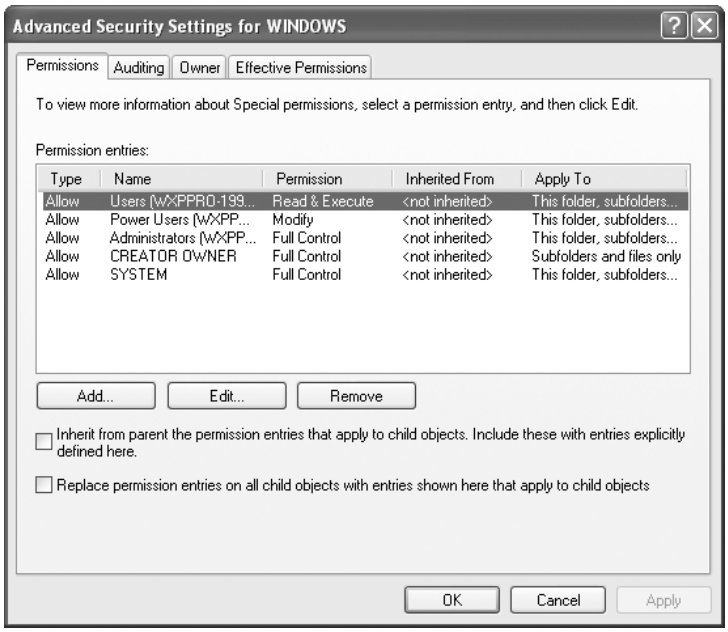

Figure 4-22 The Advanced Security Settings Properties dialog box for an NTFS object, Permissions tab

To edit the permissions of a user or group, select them from the list and click Edit. The Permission Entry dialog box (see Figure 4-23) is displayed showing all of the object-specific

permissions and the familiar Allow and Deny check boxes. The detailed NTFS object permissions are:

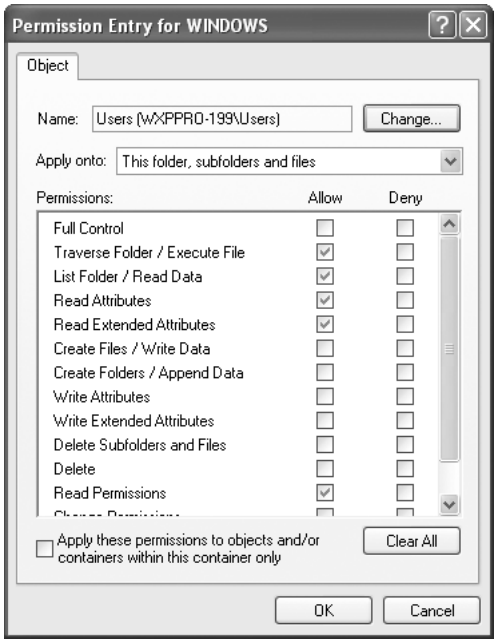

Figure 4-23 The Permission Entry dialog box

- Full Control
- Traverse Folder / Execute File
- List Folder / Read Data
- Read Attributes
- Read Extended Attributes
- Create Files / Write Data
- Create Folders / Append Data
- Write Attributes
- Write Extended Attributes
- Delete Subfolders and Files
- Delete
- Read Permissions
- Change Permissions
- Take Ownership

The Permission Entry dialog box allows you to:

- Change the user or group to which these settings apply (only on objects that do not inherit their permissions).
- Set the application of these permissions to (folders only): this folder only; this folder, subfolder, and files; this folder and subfolders; this folder and files; subfolders and files only; subfolders only; or files only.
- Clear all Allow and Deny checkboxes.
- Apply these permissions to objects and/or containers within this container only (folders only).

The Auditing tab on the Access Control Settings dialog box is used to define events that result in an audit detail being written to the Event Viewer's Security log. This tab looks and functions the same as the Permissions tab. Two checkboxes regarding inheritance appear at the bottom, but they apply to audit settings instead of permissions. Users and groups are included or deleted with the Add and Remove buttons. Selected users and groups are edited through the View/Edit button. This button reveals a similar dialog box with all of the detailed permissions. Selecting Allow or Deny on this dialog box indicates that when a user or group performs this action, an audit detail is written to the Event Viewer Security log. See Chapter 5, "Users, Groups, Profiles, and Policies" and Chapter 6 for more information on auditing.

The Owner tab lists the current owner of this object. To change ownership, select a new owner from the list of possible owners in the center field, this lists your user account and group memberships (which have Take Ownership permissions on this object). It also offers a checkbox to replace the ownership on all child elements with the settings on this object (folders only).

The Effective Permissions tab is used to view the actual permissions of a group or user for the current object based on all relevant permissions. Relevant permissions include all explicitly defined permissions directly on the object as well as all inherited permissions. Use the Select button to select the user or group to calculate the effective permissions.

NTFS Permission Basics

There are a few rules to keep in mind when working with NTFS permissions:

- NTFS object permissions *always* apply, no matter if the accessing user is local or remote (i.e., over a network through a share).
- NTFS object permissions are cumulative—all user-specific permissions are added to all group-specific memberships (assuming the user account is a member of that group), the resultant accumulation of permissions (i.e., the most permissive) is the access level enjoyed by the user.
- NTFS file permissions override any contradictory settings on the parent or container folder.

- Deny overrides all other specific Allows.
- When disabling inheritance for an NTFS object, select to either Copy the parent object's permissions to the current object or Remove permissions assigned from the parent and retain only object-specific settings. In both cases, Copy or Remove, all subsequent changes to the parent does not affect the child object.

Copying and Moving NTFS Objects

Copying and moving NTFS objects is an important subject due to the inheritance of permissions. When a new object is created, it always assumes the permissions (and other settings and attributes) of its parent or container. Keeping this in mind will help you understand what happens when an NTFS object is copied or moved. There are four different situations to keep in mind when dealing with NTFS source and destination volumes or partitions:

- Moving an object within the same volume or partition.
- Copying an object within the same volume or partition.
- Moving an object from one volume or partition to another.
- Copying an object from one volume or partition to another.

Moving an object within the same volume or partition is actually just a minor change in the location pointer for the object. Thus, its new location is not caused by creating a new file, but just changing its location address. Such objects retain their original settings.

All of the other copy and move situations involve creating a new object. This is obvious for the copy procedure, but when moving from one volume to another, a two-step process is used. First, the system copies the file to the new destination, then it deletes the original. Creating a new object causes that new object to inherit the settings of its new parent or container.

When moving or coping an object from an NTFS volume to a FAT volume, all NTFS settings are lost and the object inherits the FAT attributes and settings of its new container. When moving or copying an object from a FAT volume to an NTFS volume, the object inherits the NTFS settings and permissions of its new container.

Managing Shared Folders

The Sharing tab (see Figure 4-24), found on both FAT/FAT32 and NTFS folder Properties dialog boxes, is used to enable remote access to the folder. This tab offers the following controls:

- *Do not share this folder*—Disables sharing for this folder.
- *Share this folder*—Enable sharing for this folder.

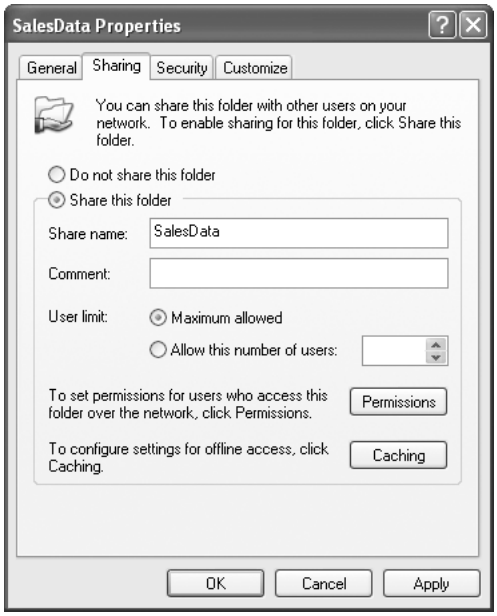

Figure 4-24 An folder object's Properties dialog box, Sharing tab

- *Share name*—The name displayed in browse lists and used in UNC names to access this share.
- *Comment*—A comment or description of the share.
- *User limit*—Used to allow the maximum possible (as determined by system speed and resources) or to limit to a specified number of simultaneous users.
- *Permissions*—This button opens the Share Permissions dialog box (see Figure 4-25), where users and groups are granted or denied Full Control, Change, or Read permissions for this folder through the share.
- *Caching*—This button opens the Caching settings dialog box, where you can enable or disable caching of resources from the current folder and set caching to automatic for documents or programs or manual for documents. This feature is used in conjunction with the Offline Files settings of Folder Options to cache network resources for use while not connected to the network.

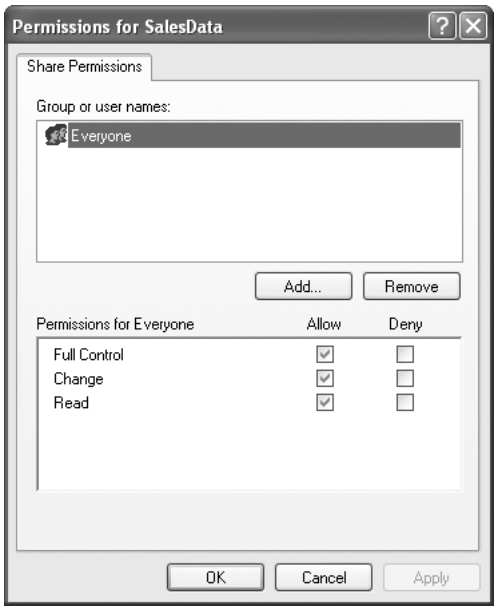

Figure 4-25 The Share Permissions dialog box

The three Share Permission levels are:

- *Read*—Allows users to access, execute, and open resources through the share.
- *Change*—Allows users to create new objects, change and delete existing objects, and to access, execute, and open resources through the share.
- *Full Control*—Allows users to perform all actions on resources through the share.

There are several important issues to keep in mind when working with shares:

- The three permission levels on a share are the only way to impose security on shared FAT volumes.
- Shares are folders not individual files.
- Share permissions only apply to the network access point; NTFS permissions must be used to grant or restrict access to objects in the shared folder.
- The default permission for a new share is Full Control for the Everyone group.
- Multiple share-permission levels due to group memberships are cumulative.
- Deny always overrides any other specifics allowed.
- The most restrictive permissions of cumulative share or cumulative NTFS apply.
- Share permissions only restrict access for network users, not local users.
- A moved folder is no longer shared.
- A copied folder is not shared, but the original folder retains its shared status.

Shared folders are easy to recognize since their folder icon now has a blue-sleeved hand supporting the folder.

Accessing shares is done either through Windows Explorer, My Network Places, or by mapping a share to a drive letter. The My Network Places can be used to access resources on the network. This tool offers several network resource access methods:

- *Add Network Place*—A Wizard used to map a share to the My Network Places interface; it does not assign a drive letter to the mapped share.
- *View Network Connections*—Switch to the Network Connections applet.
- *Computers Near Me*—Lists all computers in your domain or workgroup. Each of these can be accessed to reveal shared resources.
- *Entire Network*—Lists all domains or workgroups seen on the network. Each of these can be accessed to see members of those domains or workgroups. Each of these members can be accessed to reveal shared resources.

See Chapter 7, "Networking" for more details on network resources.

Accessing shared resources on a Microsoft network is handled through several mechanisms. First, you can map a drive using the Map Network Drive command from Windows Explorer, My Computer, or My Network Places. Second, you can access shared resources through the My Network Places tool. Third, most Open and Save dialog boxes offer a link to My Network Places allowing you to open or save files to remote paths.

Media Folders and the Customize tab

Media folders are the My Documents, My Music, and My Pictures folders. These specialized folders are the default storage locations for documents, music files, and images respectively. These three top-level media folders cannot be altered; however, any folders you add beneath them can be fully customized through the Customize tab of the folder's Properties dialog box.

The Customize tab (see Figure 4-26) is used to define the type or kind of folder the mount point represents by selecting a folder template, defining a folder picture, and customizing a folder icon.

Figure 4-26 A file object's Properties dialog box, Customize tab

- Documents (for any file type)
- Pictures (best for many files)
- Photo Album (best for fewer files)
- Music (best for audio files and playlists)
- Music Artist (best for works by one artist)
- Music Album (best for tracks from one album)
- Videos

Selecting a folder template sets the special features for the mount folder and possibly for all subfolders. Those features include task links in the quick tasks menu, viewing/playing options for graphics and audio files, and thumbnails. For example, a Music Album folder can have a thumbnail of the album cover as its folder image. In fact, if you use Windows Media Player to copy an audio CD into a folder, a thumbnail of the album cover is automatically added to the folder icon by Windows XP.

When viewing a media folder, be sure to de-select the Folders button on the toolbar in order to view the Quick Tasks list for the media type. From Quick Tasks, you can view images as slide shows, order prints of images online, and shop for new images and music online.

Simple File Sharing

Simple File Sharing is used when quick and easy file sharing is needed from a Windows XP Professional system. This feature is really only effective when Windows XP is a member of a workgroup. When enabled, as it is by default, all shared folders are accessible by everyone on the network. No individual user or group access restrictions can be defined. This feature also disables the Sharing tab on a folder/drive object's Properties dialog box. Without the Sharing tab, folders and drives are shared by drag-and-drop into the "Shared Documents" folder. This folder appears within Windows Explorer.

When disabled, shared folders can be restricted by user and group permissions. The control for Simple File Sharing is located within Folder Options, on the View tab, at the bottom of the list of Advanced Settings.

If Windows XP Professional is a member of a domain, this setting has no effect on sharing or setting share permissions.

Zipping Files and Compressed Folders

Zipped files have become the preferred method of moving large or multiple files around over the Internet. Zipped files are compressed files that house one or more files, and possibly a directory structure, into a single .zip file, such as documents.zip. Zipping files not only makes them smaller, it creates a single filename for transfer, and helps ensure delivery. Zipping started with the PKZIP command-line tool. Version 2.04G was the last release of the PKZIP tool, and it has since been the basis or standard for all zipping utilities. Many GUI utilities have been developed to simplify the zipping and extraction processes by adding drag-and-drop capabilities. WinZip is arguably the most popular of these tools.

Windows XP has zipping capabilities built right into the file system. Zipped files are treated as compressed folders. As such, they can be easily created, files and directories can be added or removed, and they can be viewed or traversed just like any other folder. The only real difference between zipped files and compressed folders is that a zipped file is a single file that contains multiple compressed file objects within it and a zipped file can be moved or transferred between systems as any other type of file. A compressed folder is just a folder with compressed contents that cannot be moved or transferred between systems easily. A new zipped file can be created using the New, Compressed (zipped) Folder command from the File menu or right-click menu from within Windows Explorer or My Computer. Zipped folders have an icon of a folder with a zipper. Once a zipped file (or compressed folder) is created, you can manipulate its contents in the exact same way as any normal folder.

CD Burning

Windows XP includes native support for writing files to a CDR or CDRW. This feature does require a compatible CDR or CDRW drive. To write files to a CD, follow these general instructions:

1. Insert a blank recordable CD into the CDR or CDRW drive.
2. **Copy** desired files and folders to the CD recording drive through Windows Explorer or My Computer.
3. Once all files are copied to the CD recording drive, **double-click the CD recording drive**. A dialog box opens that displays the temporary holding area where files and folders are stored before actually being written to the CD.
4. Verify that the files and folders, in the layout you desire, are present. Then issue the **Write these files to CD** command from the CD Writing Tasks area. This launches the CD Writing Wizard; follow its instructions.
5. Once the writing process is finished, you have the option of creating another CD with the same contents.

The CD-burning capabilities of Windows XP also include the ability to duplicate CDs, record audio CDs from other audio CDs or music files (through Windows Media Player), and erase CDRWs. For more details on using the CD-burning capabilities of Windows XP, consult the Help and Support Center.

Offline Files

One of the biggest problems with mobile computers is granting a user access to important files and documents whether they are connected to the office LAN or the Internet, or disconnected from all network mediums. Additionally, this problem is compounded by the hassles of managing file versions between the remote system and the office LAN or the Internet. To resolve this issue, Microsoft has developed a scheme known as Offline Files. Offline Files is a multi-part solution that involves file designation, data transfer, and follow-up synchronization.

From a mobile system, you can enable offline access for files and folders on a case by case basis. Simply use My Network Places or Windows Explorer to view a list of shared folders or individual files. Right-click an item you want to access while offline, then select "Make Available Offline" from the pop-up menu. The selected items will be transferred to a local storage namespace. Here is the real kicker for this tool: the files and folders made available offline are still accessed in the same manner as if they were not stored locally. Unlike briefcase from Windows NT, which made a copy of the file and required you to access the copy through the briefcase container, Offline Files does not change your access methods and maintains the duplicate offline version of the files, and all redirections completely unseen by the user. Offline File's method is much more elegant and logical than the previous schemes. When you are not connected to the network, the browse lists of

My Network Neighborhood and Windows Explorer lists only those resources cached locally. When a file or folder is marked for offline access, its icon will be altered to display a double-rotating-arrow overlay.

The first time a file is marked for offline availability, Windows XP launches a Wizard that introduces users to the feature and helps with basic configuration. All of the settings offered through the Wizard can be accessed at any time through the Offline Folders tab (see Figure 4-27) of the Folder Options command from the Tools menu of Windows Explorer. The controls on this tab are:

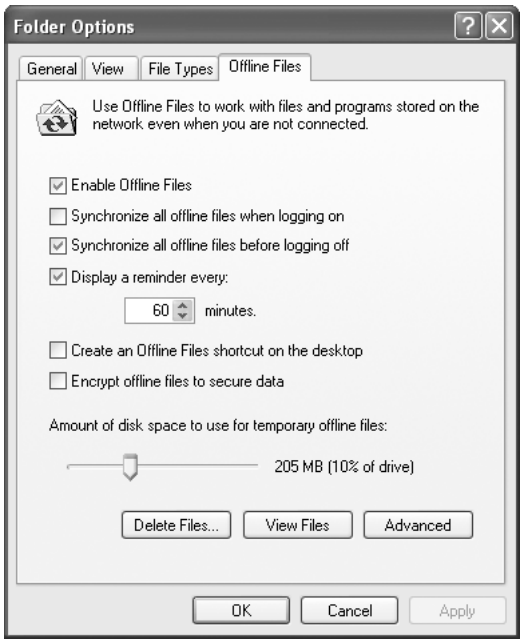

Figure 4-27 Offline Files tab of Folder Options

- Enable Offline Files
- Synchronize all Offline Files when logging on
- Synchronize all Offline Files before logging off
- Display a reminder every XX minutes
- Create an Offline Files shortcut on the desktop
- Encrypt Offline Files to secure data
- Slider to set the disk space for storing Offline Files
- Delete Files

- View Files
- Advanced—determines how to deal with computers that go offline

The ability to encrypt cached files is a new feature of Offline Files within Windows XP.

When the mobile system is reconnected to the network, Windows XP automatically synchronizes the offline files with their LAN-based originals. To alter the default, access the Synchronize Files command from the Tools menu of Windows Explorer. This interface lists all offline folders and last updated status. To disable synchronization, de-select the checkbox beside a file or folder. To configure more advanced options, click the Setup button. Through this interface, you can define whether objects are synchronized automatically upon logon or logoff, only when idle, or at scheduled times.

For more information on Offline Files, consult the *Microsoft Windows .NET Server Resource Kit* from Microsoft Press. Also, try Hands-on Project 4-12.

Folder Redirection

Folder Redirection is the mechanism of altering the physical storage location of commonly used folders to a network server while retaining the original local access methods. Folder Redirection can be configured through two different mechanisms. First, local users can alter the location of the My Documents folder through the My Document's Properties dialog box. The Target tab lists the default location: <*drive letter*>:\Documents and Settings\<*username*>\My Documents. This can be altered using the Move button to any other local or network location.

The second means of Folder Redirection occurs through Group Policy. Within a domain, site, or OU GPO under User Configuration, such folders as Windows Settings, Folder Redirection, My Documents, Application Data, Desktop, and Start menu can be redirected to a share on a network server. When a user saves a document to the My Documents folder, it is automatically saved both on the local machine and on the network share, if the user is on the network. If the user is not on the network, the document is saved to the user's hard drive. Then, when the user joins the network again, the local version of the document automatically synchronizes with the network version. If the network version of the document had also been modified in that time, the user is prompted as to whether he wants to overwrite his local version or the network version of the document or whether he wants to save both copies of the document.

When either of these redirection methods is used, the redirected items are still accessed in the exact same manner as before by each user. The redirection is handled behind the scenes, completely invisible to the end user.

Removable Media

Removable media include any storage device—whether read-only, write-once, or re-writeable—that is installed onto a Windows XP system. This includes tape devices, DVD and CD-ROM drives, optical drives, Zip/Jaz drives, Bernoulli devices, etc. If there is a device that has media that can be removed while the power is on (hot swapped), then it is a removable media device. A removable media device is installed in the same manner as any other device using either Plug and Play at startup or the Add Hardware applet.

Once installed, removable media can be configured through the Device Manager. You can also manage the media themselves (i.e., tape, disks, CD, DVD, etc.) through the Removable Storage tool found in the Computer Management tool from the Administrative Tools of the Control Panel. This tool lists all media that is present on the system and grants you the ability to create custom sets of media for backup or archival purposes. The Computer Management tool can be used to define the media type for each device, set permissions for the media device, and rename the media. We recommend that you explore the Removable Storage section of the Computer Management tool, especially if you are working with swappable media.

Troubleshooting Access Problems

In most access problems, either the resource object has the wrong settings or the user account has the wrong settings. A resource object can have incorrect permissions settings due to inheritance, lack of inheritance, moving/copying, or simple human error. A user account can have the incorrect permissions due to improper group membership, improper permission settings on a valid group, or human error.

To resolve permission or access problems, follow this procedure:

1. Determine what valid access the user should have.
2. Inspect the resource object's permissions based on groups and the specific user and what actions are set to Allow or Deny.
3. Inspect the share's permissions based on groups and the specific user and what actions are set to Allow or Deny.
4. Inspect the user's group memberships (see Chapter 5 for details on working with groups).
5. Attempt to access other resources with the user account from the same computer and a different computer.
6. Attempt to access the problematic resource with the Administrator account from the same computer and a different computer.

These steps should point you directly to the problem and how to resolve it. Taking the time to make the effort systematic prevents you from overlooking small details or the glaringly obvious.

In general, you'll want to use the following guidelines to design your permission levels and to avoid common problems:

- Grant permission only as needed.
- Rely upon NTFS to restrict access.
- Grant Full Control only when necessary, even on shares.
- Change permissions on a folder level, allow changes to affect all child elements (at least to files if not subfolders).
- Use multiple folders and subfolders to separate files into groups for different permission levels.
- Stay away from the Deny setting unless absolutely necessary.

Optimizing access to files and folders is simply a process of double verification. The first verification required is to ensure that both the share- and direct-object-level permissions grant and restrict exactly the activities you want for each user and group. The second verification required is to ensure that group memberships do not grant too much access through accumulation or prevent access due to a specific Deny when access is necessary. Both of these verification processes must be performed manually.

The Microsoft Distributed File System

The Microsoft **Distributed File System (DFS)** is a Windows 2000 or Windows .NET Server hosted service used to manipulate and manage shared resources. DFS combines shared resources from various locations throughout a network into a single hierarchical system. This allows DFS to be a single access or reference point for a logical tree structure without regard to the physical location of the resources. DFS functions by first creating a DFS root on a server system. This root looks and acts much like a share. When shared resources from other systems can be mapped under the DFS root, these are called DFS child nodes. The DFS child nodes appear as subfolders underneath the DFS root.

The benefits of DFS include:

- All network resources are organized in a single-tree structure.
- User navigation of resources is simplified because the host computer name is not required.
- Powered administration is simplified. If a server that hosts resources fails, the path to a new alternate location can be defined without affecting the path employed by users to gain access.
- Access permissions are preserved.
- The DFS root is accessed in the same way as a normal share.
- Once inside the DFS root, all other resource accesses are simplified and do not require knowing the name of the host systems.

For more information on DFS, see Windows 2000 and Windows .NET Server documentation and resource kits.

Chapter Summary

- In this chapter, you learned about basic and dynamic storage. Volume and partitions can be formatted with FAT, FAT32, or NTFS. Pre-existing basic-storage-drive configurations can be managed by Windows XP, but only dynamic devices can be used to create new multi-part drive configurations. Basic storage devices can be converted to dynamic devices without damaging the data, but to reverse the process requires that all volumes be deleted before converting them back to basic storage. The Disk Management snap-in is used to perform all drive, partition, and volume-related functions. Windows XP Professional supports simple volumes, spanned volumes, and striped volumes.
- The FAT and FAT32 file systems are retained by Windows XP for backward compatibility with other operating systems on the same multi-boot system. FAT does not offer any form of file-level security. NTFS is the recommended file system to use under Windows XP, because it offers file-level security, encryption, and **disk quotas**.
- Mount points are a new mapping method in Windows XP. This method allows volumes or partitions to be mapped to empty directories on NTFS volumes or partitions. There are several disk-related utilities: Disk Cleanup, Check Disk, and Disk Defragmenter.
- All file system objects within Windows XP have unique properties and controls. In addition, all NTFS objects offer security, encryption, compression, and auditing. NTFS permissions are used to control access to resources. Shares are used to grant access to local resources from across a network.
- Windows XP includes support for Simple File Sharing, zipped files, CD burning, folder redirection, management of removable media, and support for DFS.

Key Terms

active (marked active) — The status of a primary partition that indicates to the computer's BIOS that it hosts the necessary files to boot an operating system.

auditing — The recording of the occurrence of a defined event or action.

basic storage — The drive division method that employs partitions.

boot partition — The partition that hosts the main Windows XP system files and is the initial default location for the paging file. The boot partition can be the same partition as the system partition or it can be any other partition (or logical drive in an extended partition) on any drive hosted by the computer.

cluster — A group of one or more sectors into a single non-divisible unit.

defragmentation — The process of reorganizing files so that they are stored contiguously and no gaps are left between files.

Disk Management — The MMC snap-in used to manage drives.

disk quota — A feature in Windows that allows you to limit the amount of disk space that can be consumed by a user.

Distributed File System (DFS) — Combines shared resources from various locations throughout a network into a single hierarchical system.

drive letter — One of two methods of accessing formatted volumes under Windows XP. A drive letter can be assigned to a partition or volume or a drive configuration of multiple components.

dynamic storage — The drive division method that employs volumes. It is a new standard supported only by Windows XP and Windows 2000.

extended partition — A type of partition on a basic disk that can be divided into logical drives. Only a single extended partition can exist on a physical disk. When present, only three primary partitions can exist.

FAT (FAT16) — The 16-bit File Allocation Table file system originally introduced with DOS. As supported under Windows XP, it can be used to format partitions or volumes up to 4 GB.

FAT32 — The 32-bit FAT file system. As supported under Windows XP, it can be used to format partitions or volumes up to 32 GB.

fragmentation — The division of a file into two or more parts, where each part is stored in a different location on the hard drive. As the level of fragmentation on a drive increases, the longer it takes for read and write operations to occur.

long file names (LFN) — Filenames up to 256 characters in length, supported by all file systems under Windows XP.

mirrored volume — A drive configuration of a single volume is duplicated onto another volume on a different hard drive. Provides fault tolerance. Mirrored volumes are not available on Windows XP.

mount point or mounted volume — A new drive-access technique that maps a volume or partition to an empty directory on an NTFS volume or partition.

NTFS (New Technology File System) — The preferred file system of Windows XP. Supports file-level security, encryption, compression, auditing, and more. Supports volumes up to 2 TB.

primary partition — A type of partition on a basic disk that can be marked active. Up to four primary partitions can exist on a physical disk.

RAID-5 volume (Redundant Array of Inexpensive Disks) — A drive configuration of three or more parts (up to 32) of one or more drives or three or more entire drives (up to 32). Data is written to all drives in equal amounts to spread the workload, and parity information is added to the written data to allow for drive failure recovery. Provides fault tolerance. If one partition or drive fails in the set, the other members can re-create the missing data on the fly. Once the failed member is replaced or repaired, the data on that drive can be rebuilt and restored. This is also known as disk striping with parity. RAID-5 volumes are not available on Windows XP.

removable storage device — Any type of floppy, cartridge, or drive that can be either removed between reboots or as a hot swappable device.

sector — The smallest division (512 bytes) of a drive's surface.

share — A resource that can be accessed over the network.

simple volume — A drive configuration of all or part of a single drive. Does not provide any fault tolerance. NTFS volumes can be extended; FAT and FAT32 volumes cannot be extended.

spanned volume — A drive configuration of two or more parts (up to 32) of one or more drives or two or more entire drives, the elements of the spanned volume do not have to be equal in size. Data is written to the first drive in the volume until it is full, then it continues on with the next drive. It is also called an extended volume. Does not provide any fault tolerance. If one partition or drive in the set fails, all data is lost. Spanned volumes cannot be part of a striped volume or a mirrored volume. NTFS spanned volumes can be extended; FAT and FAT32 spanned volumes cannot be extended. The system partition/volume and boot partition/volume cannot be extended. Volume sets can be reduced in size only by breaking the set and creating a new set. The act of breaking the set destroys all data stored on the volume. Spanned volumes are not available on Windows XP.

striped volume — A drive configuration of two or more parts (up to 32) of one or more drives or two or more entire drives (up to 32). Data is written to all drives in equal amounts (in 64 KB units) to spread the workload and improve performance. Each part or drive must be roughly equal in size. Does not provide any fault tolerance. If one partition or drive in the set fails, all data is lost. Striped volumes cannot be mirrored or extended. Striped volumes are not available on Windows XP.

system partition — The partition that is the active partition where the boot files required to display the boot menu and initiate the booting of Windows XP are stored.

volume — With basic storage, it is a collection of two to 32 partitions into a single logical structure. With dynamic storage, it is any division of a physical drive or collection of divisions into a drive configuration.

Review Questions

1. Which storage method employs primary and extended partitions?
   a. Logical drives
   b. Basic
   c. Dynamic
   d. Spanned volumes
2. When logical drives are present on a basic storage device, how many primary partitions can exist?
   a. 1
   b. 2
   c. 3
   d. 4

3. Which of the following statements are true about a volume set?
   a. Combines two or more volumes into a single logical storage area
   b. Provides fault tolerance
   c. If one element of the set fails, all data in the set is lost
   d. It can be assigned a single drive letter
4. A 4 GB partition or volume can be formatted with what file system?
   a. FAT
   b. FAT32
   c. HPFS
   d. NTFS
5. What mechanism(s) of Windows XP allow you to access more than 24/26 volumes on a single system?
   a. Shares
   b. Drive letters
   c. DFS
   d. Mounted volumes
6. Under Windows XP Professional, it is possible to create new RAID-5 volumes on dynamic and basic drives. True or False?
7. Which partition hosts the main Windows XP system files and is the initial default location for the paging file?
   a. system partition
   b. boot partition
   c. logical partition
   d. dynamic partition
8. The drive configurations supported by Windows XP Professional provide fault tolerance. True or False?
9. What is the best file system for a 250 MB volume?
   a. FAT
   b. FAT32
   c. NTFS
10. NTFS volumes created under Windows XP cannot be accessed by any other operating system. True or False?

11. Which of the following are true for NTFS under Windows XP?
    a. Supports volumes up to 2 TB in size
    b. File-level compression, encryption, auditing, and security
    c. Disk quotas
    d. POSIX file system support
    e. Most efficient on volumes smaller than 512 MB
12. Drives can be converted to and from dynamic storage without damaging the hosted data. True or False?
13. The Properties dialog box for a partition or volume gives you quick access to which drive tools?
    a. Check Disk
    b. Defragmentation
    c. Disk Cleanup
    d. Device Manager
    e. Backup
    f. Event Viewer
14. A volume or partition can be attached to a mount point on any other volume or partition. True or False?
15. Quotas can be defined in what manner(s)?
    a. By user
    b. By drive
    c. By group
    d. By volume or partition
16. Disk Cleanup is used to free space on a hard drive by removing orphaned files, cleaning out the Recycle bin, and shrinking the page file. True or False?
17. The built-in defragmentation utility can be scheduled to automatically reorganize local hard drives. True or False?
18. Which of the following are properties of NTFS file or folder objects but not of FAT file or folder objects?
    a. Attributes: Read-only
    b. Compress contents to save disk space
    c. Attributes: Archive
    d. Encrypt contents to secure data
19. What methods can be used to prevent a user from gaining access to an NTFS resource?
    a. Do not include the user account (or its groups) in the list of permissions
    b. Set the user account's permissions to Deny

c. Set the user account's permissions to No Access
d. Place the user account in the Guests group

20. NTFS object permissions are used only when a user is local. True or False?
21. Which of the following are true?
    a. Child objects can inherit the permissions of their parent containers
    b. Coping files always retain the original settings
    c. File-level permissions always override contradictory settings on the parent container
    d. Deny overrides all other specific Allows
22. Files moved from an NTFS volume to a FAT volume and then to another NTFS volume re-assume their original settings. True or False?
23. Which of the following statements is true about shares?
    a. Offers only three levels of permissions
    b. Can be cached on client systems
    c. Can restrict simultaneous users
    d. Can be individual files or folders
    e. Overrides NTFS permissions
    f. The most restrictive permissions of cumulative share and cumulative NTFS apply
24. To grant varying levels of access within a share, use NTFS permissions and group files into subfolders. True or False?
25. Which of the following statements is true about the Microsoft Distributed File System?
    a. All network resources are organized in a single-tree structure
    b. Access permissions are preserved
    c. A DFS root can be hosted by Windows XP Professional
    d. Once inside the DFS root, all other resource accesses are simplified and do not require knowing the name of the host systems

HANDS-ON PROJECTS

Project 4-1

To create a partition on a basic drive:

This hands-on project requires that a basic drive with unallocated space be present in the system. Additionally, the drive must have either only three primary partitions or only two primary partitions if an extended partition is present. This project also assumes the Control Panel is in Classic View.

1. Open the Control Panel (**Start**|**Control Panel**|**Switch to Class View**).

2. Double-click the **Administrative Tools** applet's icon.
3. Double-click the **Computer Management** tool's icon.
4. Expand the **Storage** console node if necessary (click the plus sign to the left of the node).
5. Select **Disk Management**.
6. Right-click an unallocated area of a basic drive, and select **New Partition** from the pop-up menu.
7. The New Partition Wizard launches. Click **Next**.
8. Select **Primary Partition**. Click **Next**.
9. Select the amount of space to use in this partition. **Accept the default of the maximum space available**. Click **Next**.
10. Assign a drive letter. Accept the default. Click **Next**.
11. Select the file system to format this partition. Accept the default of NTFS. Click **Next**.
12. The Wizard displays a list of the actions to be performed in creating this partition. Click **Finish**. The system creates the partition, formats the drive, and assigns the drive letter. The display of the drive will be updated to reflect the new partition.

Project 4-2

To mark a partition active on a basic drive:

This hands-on project requires that Hands-on Project 4-1 be completed first.

1. Take note of which partition is currently marked active: **Healthy (Active)** if applicable.
2. Right-click the partition created in Hands-on Project 4-1.
3. Select **Mark Partition as Active** from the pop-up menu. The Disk Management drive display shows the partition as active: Healthy (Active).
4. Right-click the partition that was marked active at the beginning of this hands-on project.
5. Select **Mark Partition as Active** from the pop-up menu.
6. The Disk Management drive display shows the original partition as active: **Healthy (Active)**.

Project 4-3

To change a drive letter on a volume or partition:

1. Right-click a partition or volume. Be sure not to select the boot or system partition. Select **Change Drive Letter and Paths** from the pop-up menu.

2. Select the current drive letter; click **Change**.
3. Select the **Assign a drive letter** radio button.
4. Use the pull-down list to **select a different letter for this drive**.
5. Click **OK**.
6. You'll be warned about changing drive letters. Click **Yes**. The Disk Management display reflects the drive letter change.

Project 4-4

To create a mounted volume or mount point:

This project requires that at least two partitions be present on the system. Partition A must be formatted with NTFS. Partition B can be any partition other than the boot or system partitions.

1. Locate Partition A. **Take note of its drive letter:** _____
2. Right-click Partition B; select **Change Drive Letter and Paths** from the pop-up menu.
3. Click **Add**.
4. Make sure the **Mount in the following empty NTFS folder** option is selected.
5. Click **Browse**.
6. Locate Partition A by using its drive letter (see step 1). **Select the drive letter**.
7. Click **New Folder**.
8. Type in a name for the new folder, such as **MapPartB**; press **Enter**.
9. Make sure the newly created folder is highlighted. Click **OK**.
10. The path to the new folder is now listed in the text field under the Mount in the following empty NTFS folder option. Click **OK**.
11. Open Windows Explorer (**Start** | **All Programs** | **Accessories** | **Windows Explorer**).
12. Expand **My Computer**.
13. Expand **Partition A**.
14. Notice the mounted volume appears as a drive icon with the name of the folder you created. **Select the mount point**. Notice that the contents of Partition B are displayed in the right pane.
15. Close Windows Explorer (**File** | **Close**).

Project 4-5

To delete a mounted volume or mount point:

This hands-on project requires that Hands-on Project 4-4 be completed.

1. Right-click **Partition B** from Hands-on Project 4-4, select **Change Drive Letter and Paths** from the pop-up menu.
2. Select the mounted volume mapping (i.e., the listed mount point).
3. Click **Remove**.
4. You'll be asked to confirm the deletion. Click **Yes**.

Project 4-6

To delete a partition from a basic drive:

This hands-on project requires that Hands-on Project 4-1 be completed.

1. Select the partition created in Hands-on Project 4-1.
2. **Right-click the partition** and select **Delete Partition** from the pop-up menu.
3. To confirm the deletion, click **Yes**.

Project 4-7

To convert a basic drive to a dynamic drive:

This hands-on project requires that a second hard drive (a basic drive) be present on the system.

1. Select a basic disk in Disk Management. The selected disk cannot host the system partition.
2. **Right-click** the basic disk, and select **Convert to Dynamic Disk** from the pop-up menu.
3. Click the **Convert** button on the Disk to Convert dialog box and confirm the conversion by clicking **Yes** to any warning messages that may appear.
4. A list of all hard drives present on the system is displayed. The disk you selected will already be checked. Do not change the status of the checkboxes on this list. Click **OK**. Disk Management displays the drive as Dynamic.

Project 4-8

To create a volume on a dynamic drive:

This hands-on project requires that Hands-on Project 4-7 be completed.

1. Right-click the unallocated space on a dynamic drive; select **New Volume** from the pop-up menu.
2. This launches the New Volume Wizard. Click **Next**.
3. Select the volume type to create. In this case, select **Simple volume**. Click **Next**.
4. For a simple volume you need only unallocated space from a single drive. Make sure the drive is listed in the Selected dynamic disk field.
5. In the Select the amount of space in MB field, enter an amount of about half of the maximum available space. Click **Next**.
6. Assign a drive letter. **Accept the defaults**. Click **Next**.
7. Select the file system to format the new volume. Accept the default of NTFS. Click **Next**.
8. The Wizard displays a list of actions to be performed in creating the new volume. Click **Finish**.

Project 4-9

To extend a volume:

This hands-on project requires that Hands-on Project 4-8 be completed.

1. Right-click the volume created in Hands-on Project 4-8; select **Extend Volume** from the pop-up menu.
2. The Extend Volume Wizard launches. Click **Next**.
3. Make sure the drive with unallocated space is listed in the Selected dynamic disk field.
4. Change the size of the remaining unallocated space to add to the existing volume to 80 percent of that available (if there is 200 MB remaining, change the number to 180). Click **Next**.
5. The Wizard displays a list of actions to perform in extending the volume. Click **Finish**. Disk Management displays the extension with the same drive letter as the original volume.

Project 4-10

To delete a volume:

This hands-on project requires that Hands-on Project 4-8 be completed. Hands-on Project 4-9 is not required.

1. Right-click the volume created in Hands-on Project 4-8, and select **Delete Volume** from the pop-up menu.
2. To confirm the deletion, click **Yes**. Disk Management displays the drive that is not hosting volumes and consists only of unallocated space.

Project 4-11

To revert a dynamic drive to a basic drive:

This hands-on project requires that Hands-on Project 4-10 be completed.

1. Right-click the drive used in Hands-on Projects 4-7 through 4-10. (If any volumes are still present, perform Hands-on Project 4-10 to delete them.)
2. Select **Convert to Basic Disk** from the pop-up menu. Disk Management displays the drive as Basic.

Project 4-12

To create and disable Offline Files:

This hands-on project requires that Windows XP Professional be a client in a Microsoft Windows Network and that some online resources are available through a share.

1. Open Windows Explorer (**Start** | **All Programs** | **Accessories** | **Windows Explorer**).
2. Expand the My Network Places area of Windows Explorer.
3. Locate and select a share on any accessible network host.
4. Right-click the selected share and select **Make Available Offline** from the pop-up menu. This launches the Offline Files Wizard.
5. Click **Next**.
6. Verify that the Automatically synchronize the Offline Files when I log on and log off my computer checkbox is selected. Click **Next**.

7. Verify that the Enable reminders checkbox is selected and the Create a shortcut to the Offline Files folder on my desktop checkbox is not selected. Click **Finish**.
8. Select **Yes, make this folder and all its subfolders available offline**, then click **OK**. (This action will not appear if the select folder does not have subfolders.) After the synchronization process, all files that are stored as Offline Files have a small, double-arrow image added to their icon to identify them.
9. To disable Offline File support, select an enabled folder, right-click, and select **Make Available Offline**. This removes the checkbox beside this command and removes the files from local cached storage.

Project 4-13

To compress and decompress a folder:

This hands-on project requires that Windows XP be installed and an NTFS partition is present.

1. Launch **Windows Explorer** (**Start**|**All Programs**|**Accessories**|**Windows Explorer**).
2. Locate and select any folder on your hard drive, such as C:\Program Files.
3. Right-click the folder, then select **Properties** from the pop-up menu.
4. On the **General** tab, take note of the Size and Size on disk values.
5. On the General tab, click the **Advanced** button.
6. Select the **Compress contents to save disk space** checkbox.
7. Click **OK**.
8. Click **OK**.
9. Select the **Apply changes to this folder, subfolders and files** radio button.
10. Click **OK**. The system will compress the folder and its contents (this may take several minutes).
11. Right-click the same folder again, then select **Properties** from the pop-up menu.
12. On the **General** tab, take note of the Size and Size on disk values. The Size on disk value should be smaller than the original value.
13. On the General tab, click the **Advanced** button.
14. De-select the **Compress contents to save disk space** checkbox.
15. Click **OK**.
16. Click **OK**.
17. Select the **Apply changes to this folder, subfolders and files** radio button.
18. Click **OK**. The system will de-compress the folder and its contents; this may take several minutes.

Project 4-14

To optimize folder access:

This hands-on project requires that Windows XP be installed and that an NTFS partition is present. The XP client must either be a domain member or it must have Simple File Sharing disabled.

1. Launch **Windows Explorer** (**Start**|**All Programs**|**Accessories**|**Windows Explorer**).
2. In the left pane, select a drive formatted with NTFS within My Computer.
3. In the right pane, select a folder.
4. Select **File**|**Properties**.
5. Select the **Security** tab.
6. Click the **Add** button.
7. Click the **Advanced** button.
8. Click the **Find Now** button.
9. Locate and select the **Authenticated Users** group.
10. Click **OK**.
11. Click **OK**.
12. Click the **Authenticated Users** group that now appears in the list of names on the Security tab for the NTFS object. Take note of the granted permissions.
13. Select the **Sharing** tab.
14. Select the **Share this folder** radio button.
15. Click the **Permissions** button.
16. Click the **Add** button.
17. Click the **Advanced** button.
18. Click the **Find Now** button.
19. Locate and select the **Authenticated Users** group.
20. Click **OK**.
21. Click **OK**.
22. Set the Share permissions for the Authenticated Users group as close to the NTFS file level permissions as possible.
23. Click **OK**.
24. Click **OK.**
25. In Windows Explorer, select **File**|**Close**.

Project 4-15

To share a folder and remove a share:

This hands-on project requires that Windows XP be installed and that an NTFS partition is present. The XP client must either be a domain member or it must have Simple File Sharing disabled.

1. Launch **Windows Explorer** (**Start**|**All Programs**|**Accessories**|**Windows Explorer**).
2. In the left pane, select a drive formatted with NTFS within My Computer.
3. In the right pane, select a folder.
4. Select **File**|**Sharing and Security**.
5. Select the **Share this folder** radio button.
6. Click the **Permissions** button.
7. Click the **Add** button.
8. Click the **Advanced** button.
9. Click the **Find Now** button.
10. Locate and select the **Authenticated Users** group.
11. Click **OK**.
12. Click **OK**.
13. Click **OK**.
14. Notice the folder now has a shared hand on its icon.
15. With the folder still selected, select **File**|**Sharing and Security**.
16. Select the **Do not share this folder** radio button.
17. Click **OK**.
18. Notice the shared hand on the folder icon disappears.

Project 4-16

To convert a FAT partition to NTFS:

This hands-on project requires that a FAT volume exists on your Windows XP system. This volume will be converted to NTFS. Proceed only if the conversion of this volume will not compromise your system.

1. Select **Start**|**All Programs**|**Accessories**|**Command Prompt**.
2. Change drives to the FAT partition, such as typing **g:**. Then press **Enter**.
3. Type **convert *g:* /fs:ntfs /v** where *g:* is the drive letter of the FAT volume to convert; press **Enter**.

4. Provide the current label for the drive to be converted, look in Windows Explorer to see what the volume name is. Press **Enter** after you have typed in the volume label.
5. You'll be prompted whether to complete the conversion at the next reboot; press **Y**.
6. **Reboot**. The drive will be converted as part of the startup process.

Project 4-17

To map to a network drive:

This hands-on project requires that the Windows XP Professional be a client on a network with at least one shared folder available for mapping.

1. Launch **Windows Explorer** (**Start**|**All Programs**|**Accessories**|**Windows Explorer**).
2. Select **Tools**|**Map Network Drive**.
3. Click the **Browse** button.
4. Using the browse list, locate and select a shared folder from the network.
5. Click **OK**.
6. Select a drive letter using the pull-down list next to **Drive**.
7. Deselect the **Reconnect at logon** checkbox.
8. Click **Finish**.

CASE PROJECTS

1. You must test new media software that plays large multimedia presentations (often 3 MB or larger). The software is being developed for Windows 98, Windows NT, and Windows XP. Can you configure a multi-boot system with all three of these operating systems in such a way that a single drive can host at least six media presentations that can be accessed from all three operating systems? If so, how? If not, what other solution(s) can be used?
2. The security requirements of your organization state that log files of system access must be retained for at least six months on live accessible drives. In the past, these log files consumed at least 6 GB of drive space per month. However, they are growing larger and at an accelerated rate. Because you don't know exactly how much drive space you'll need over the next six months to a year, what options do you have under Windows XP to comply with the organization's security requirements?